AIR FORCE

QUALIFICATION TRAINING PACKAGE (AFQTP)

for

PAVEMENTS AND CONSTRUCTION EQUIPMENT OPERATOR

(3E2X1)

MODULE 23

PAVED SURFACES

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MODULE 23

PAVED SURFACES

Career Field Education and Training Plan (CFETP) references from 1 Apr 97 version.

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AIR FORCE QUALIFICATION TRAINING PACKAGES
for
PAVEMENTS AND CONSTRUCTION EQUIPMENT OPERATOR
(3E2X1)

INTRODUCTION

Before starting this AFQTP, refer to and read the "Trainee/Trainer Guide" located on the AFCESA Web site **http://www.afcesa.af.mil/**

AFQTPs are mandatory and must be completed to fulfill task knowledge requirements on core and diamond tasks for upgrade training. ***It is important for the trainer and trainee to understand*** that an AFQTP ***does not*** replace hands-on training, nor will completion of an AFQTP meet the requirement for core task certification. AFQTPs will be used in conjunction with applicable technical references and hands-on training.

AFQTPs and Certification and Testing (CerTest) must be used as minimum upgrade requirements for Diamond tasks.

MANDATORY minimum upgrade requirements:

Core task:
AFQTP completion
Hands-on certification

Diamond task:
AFQTP completion
CerTest completion (80% minimum to pass)

Note: *Trainees will receive hands-on certification training for Diamond Tasks when equipment becomes available either at home station or at a TDY location.*

Put this package to use. Subject matter experts under the direction and guidance of HQ AFCESA/CEOT revised this AFQTP. If you have any recommendations for improving this document, please contact the Career Field Manager at the address below.

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GENERAL PAVEMENT FUNCTIONS

MODULE 23 **AFQTP UNIT 1**

LAY OUT AREA (23.1.1.)

LAY OUT AREA

Task Training Guide

STS Reference Number/Test:	23.1.1. Lay out Area
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Line Level • String Line • Stakes • Tape Measure • Personal Safety Equipment • General Tool Kit
Learning Objective:	• The trainee will be able to properly layout an area for pavement.
Samples of Behavior:	• The trainee demonstrates how to lay out a small area.
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

LAY OUT AREA

Background: Before any construction project is started, it must be well planned. You may get involved in some planning activities in construction and repair projects. A well-planned project will make your job easier and safer. Regardless of size of the job, make sure you have the proper safety equipment before you start. The selection of the proper tools to complete a job is just as important as the proper safety equipment. Certain tools are designed for certain jobs.

Site preparation is a very important part of building a road, runway, or sidewalk. The amount of preparation depends on the terrain, location, and expected use of the completed surface. During the layout phase of our construction project, measure the dimensions of the area and then mark them to give a guide to go by. The method used to layout a project will be determined by the size of the area.

The first thing to do is measure the area. Small sized projects such as patios and sidewalks can be effectively laid out with a tape measure, string, and line level. This will give you the proper dimensions but remember, when laying out an area for rigid pavement, don't forget to allow additional room for concrete forms. After the area has been laid out to the exact dimensions, place construction stakes in the ground and attach a string line between them. Hook on a line level and raise or lower one end of the string to obtain the desired slope.

> NOTE
> Do not use a line level for string that expands a distance greater than 25 feet. The string will sag and you will receive an incorrect reading.

The layout of a large area will require a great deal of work and cooperation between different shops in the CE organization. This section will concentrate on laying out a small area.

To perform this task, follow these steps:

Step 1: Measure area

Measure the area using a tape measure. Make sure enough room was allowed for concrete forms if accomplishing rigid pavement construction.

Step 2: Place stakes

Place construction stakes outlining your project. Attach string to the stakes and place a line level on the string. Raise or lower the string to obtain the desired slope. When doing a square or rectangular concrete pad, use a triangle stake setup on the corners (Figure 1), this will allow room for forms at the corners.

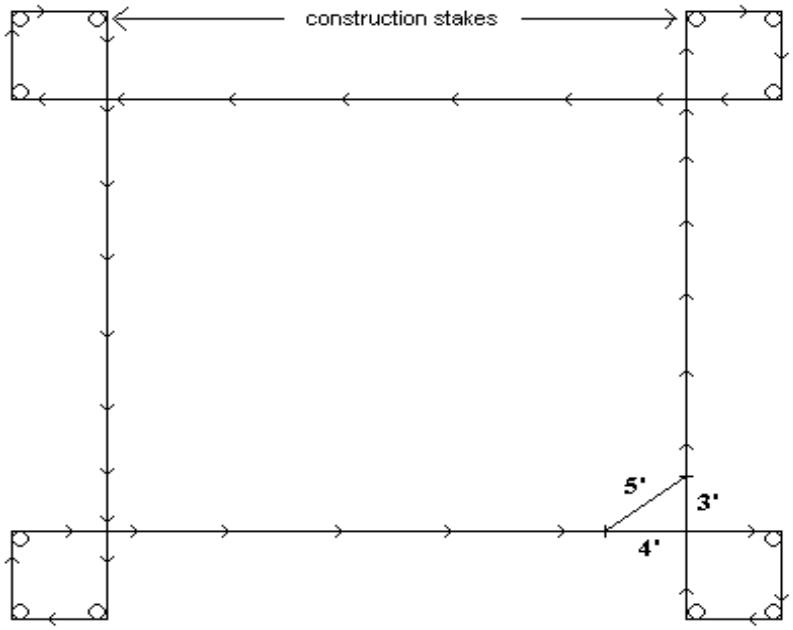


Figure 1, Project Layout Diagram.

Step 3: Check Square

It is important to ensure your project is square. There are two methods to accomplish this. First, measure from one corner diagonally across to the other corner. Then measure the opposite corners and the measurement on both distances should be the same. The other method involves using the Pythagorean theorem or $A^2 + B^2 = C^2$. This method is commonly known as the 3/4/5 method. It involves measuring 3 feet out from a corner and making a mark on the string line. Then measure 4 feet out from the corner in the opposite direction and make a mark, then measure diagonally across the two marks; the measurement should be 5 feet if the corner is square. (See Figure 1). It is a good idea to use both methods to ensure the project is square.

Review Questions
for
Lay out Area

Question	Answer
1. What is the first step when laying out a small area?	a. Establish project boundaries using the 3/4/5 method b. Clear the area with a loader c. Measure the area using a tape measure d. Establish slope using a line level
2. What is one method used to ensure the corners are square?	a. Measure diagonally across corners b. Walk the distance and if it's the same number of steps, then it's square c. Look down all four sides and you will be able to square it off of site d. Use line level

LAY OUT AREA

Performance Checklist		
Step	**Yes**	**No**
1. Measured area?		
2. Placed stakes?		
3. Checked to ensure area is square?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

GENERAL PAVEMENT FUNCTIONS

MODULE 23 **AFQTP UNIT 1**

CLEAR AREA USING:

HAND TOOLS (23.1.2.1.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training if equipment is available. It is to be used in conjunction with these for training purposes only.

CLEAR AREA USING:

HAND TOOLS

Task Training Guide

STS Reference Number/Title:	23.1.2.1. Hand Tools
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Hand Tools (Depending on size and scope of project) • Personal Safety Equipment • General Tool Kit
Learning Objective:	• The trainee will be able to properly clear an area using hand tools
Samples of Behavior:	• The trainee demonstrates how to clear an area using hand tools.
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

CLEAR AREA USING:

HAND TOOLS

Background: Clearing vegetation and trees is usually necessary before moving and shaping the ground. Clearing includes removing surface boulders and other materials embedded in the ground and disposing of the cleared material. Ensure that environmental protection considerations are addressed before conducting clearing operations. Plan clearing operations to permit disposal of all debris in one handling. Specifications may allow shearing of the vegetation and trees at ground level, or it may be necessary to grub (removing stumps and roots from below the ground). Project specifications will dictate the proper clearing techniques.

Hand tools Sometimes during clearing operations you may have to utilize smaller tools to help remove vegetation, trees, brush, and rocks. Some tools that may be used include picks, mattocks, axes, round point shovels, and chain saws. The picks and mattocks are used to dig around stumps to help remove roots or boulders. The round point shovel is also used to dig up roots and to dig around stumps. Axes are used to chop down small saplings and very small trees. Chainsaws can be used for small trees as well as very large trees. Always remember to select the right tool for the right job. This will save time, effort, and money.

To perform this task, follow these steps:

Step 1: Conduct a job site visit

Use this visit to look at the area needing cleared. Think about the tools and materials you will need to accomplish the job. If the boundaries of the area are not laid out, take time to do this now.

Step 2: Develop a project checklist

Write down details about the job while you are on site. This may include hand tools needed for clearing, utilities in the area that need to be worked around, and any other information to make it easier to accomplish the job. Once complete return to the shop and refer to the checklist. Make sure nothing is forgotten so you do not have to stop work and return to the shop for additional items.

Step 3: Clear the area

Ensure you are wearing the appropriate personal protective equipment and using the tool properly. Using the picks, mattocks, round point shovels, axes, or chainsaws, clear the area making.

Step 4: Clean and store tools

After each job, ensure each tool is clean prior to putting them back in the tool room. Store the tools in the correct place in the tool room. This helps to keep the tool room clean and organized. If a tool is broken either repair or replace that tool.

Review Questions for Clear Area Using:

Hand Tools

Question	Answer
1. What hand tools are used to dig up stumps and roots?	a. Picks b. Mattocks c. Round point shovels d. All of the above
2. Which hand tool is used for chopping down saplings or very small trees?	a. Axe b. Pick c. Mattocks d. Chainsaw
3. What hand tool is used to cut down small to very large trees?	a. Axe b. Pick c. Mattock d. Chainsaw

CLEAR AREA USING:

HAND TOOLS

Performance Checklist		
Step	**Yes**	**No**
1. Conducted site visit identifying appropriate tools to use for clearing area?		
2. Developed a project checklist?		
3. Cleared area of vegetation, brush, trees, and rocks utilizing the correct tool and wearing appropriate personal protective equipment?		
4. After completing job, cleaned and returned tools to their proper location?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

GENERAL PAVEMENT FUNCTIONS

MODULE 23 **AFQTP UNIT 1**

CLEAR AREA USING:

CONSTRUCTION EQUIPMENT (23.1.2.2.)

CLEAR AREA USING:

CONSTRUCTION EQUIPMENT

Task Training Guide

STS Reference Number/Title:	23.1.2.2. Construction Equipment
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Assorted Heavy Equipment • Personal Safety Equipment
Learning Objective:	• The trainee will be able to properly clear an area using construction equipment
Samples of Behavior:	• The trainee demonstrates how to clear an area using construction equipment
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

CLEAR AREA USING:

CONSTRUCTION EQUIPMENT

Background: Clearing vegetation and trees is a necessity before moving and shaping the landscape. Clearing includes removing surface boulders and other materials embedded in the ground and disposing of cleared material. Ensure environmental protection considerations are addressed before conducting clearing operations. Plan clearing operations to permit disposal of all debris in one handling. Specifications may allow shearing of the vegetation and trees at ground level or it may be necessary to grub (removing stumps and roots from below the ground). Project specifications will dictate the proper clearing techniques.

Bulldozers Typically, bulldozers are used to clear large areas of brush, trees, and rocks. When using bulldozers to remove trees, it is best to travel in one direction when clearing. Changing direction tends to skin and scrape trees instead of uprooting them and allowing a clean cut. Clearing techniques vary with the type of vegetation being cleared, the soil type, and the soil's moisture condition. Table 2-1 shows average clearing rates for normal clearing jobs using various size bulldozers.

Table 2-1. Quick Production Estimates for Normal Area Clearing

Equipment	Equipment (Hours Per Acre)		
	Light (12 Inches or Less*)	**Medium (12 to 18 Inches*)**	**Heavy (18 Inches*)**
Bulldozer:			
Medium tractor	2.5	5.0	10.0
Heavy tractor	1.5	3.0	8.0
Shear blade:			
Medium tractor	0.4	0.8	1.3
Heavy tractor	0.3	0.5	0.8
*Maximum tree size NOTE: These clearing rates are average for tree counts of 50 trees per acre. Adverse conditions (slopes, rocks, and soft ground) can reduce rates significantly.			

Brush and Small Trees

Moving the bulldozer with the blade slightly below ground level usually removes small trees and brush. The blade cuts, breaks off, or uproots most of the tree and bends the rest for removal on the return trip.

Medium Trees

To remove a medium-size tree (12 to 18 inches in diameter) raise the blade as high as possible to gain added leverage and push the tree over slowly. As the tree starts to fall, back away the bulldozer quickly to avoid the rising roots. Then lower the blade and drive the bulldozer forward, while lifting out the roots. The average time for a medium tractor with a bulldozer blade to clear and pile medium trees is approximately 6 minutes per tree.

Large Trees

Removing large trees (18 inches and greater in diameter) is much slower and more difficult than clearing brush and smaller trees. First, gently and cautiously probe the tree for dead limbs that could fall. Determine the tree's natural direction of lean and set up to push the tree in that direction. Position the blade high and center it on the tree for maximum leverage. If possible, try to push the tree in the same way as a medium tree. However, if the tree has massive, deeply embedded roots, use the following method (Figure 2-4):

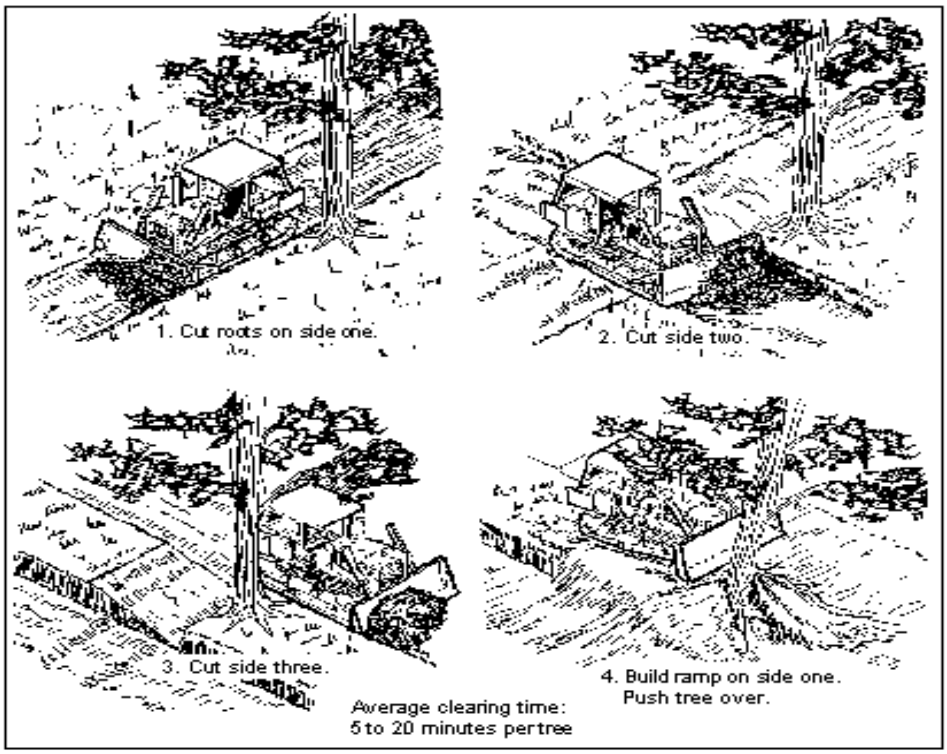


Figure 2-4

Four Steps for Removing a Large Tree with a Massive, Deeply Embedded Root System

Step 1. Start on the side opposite the proposed direction of fall, and make a cut deep enough to severe some of the large roots. Make the cut like a V-ditch, tilted downward laterally toward the roots.

Step 2. Cut side two the same way.

Step 3. Cut side three the same way.

Step 4. Build an earth ramp on the same side as the original cut to obtain greater pushing leverage. Then push the tree over and as it starts to fall, reverse the bulldozer quickly to avoid the rising roots. After falling the tree, fill the stump hole to prevent the collection of water.

The average time for a medium tractor with a bulldozer blade to clear and pile large trees is approximately 12 minutes per tree. The time required to clear and pile massive trees requiring this four-step procedure will often be more than 20 minutes each.

NOTE The roots on the fourth side may also need to be cut. CAUTION The tree may free fall after cutting the roots on all four sides.

Roots

Mount a rake on the bulldozer in place of the blade to remove roots and small stumps. As the bulldozer moves forward, the teeth of the rake are forced below the surface. The teeth will catch the roots and surface brush left from the felling operation, while the soil remains or passes through.

Safety Precautions

Never operate clearing tractors too close together. Do not follow a tree too closely when pushing it, because when it begins to fall, its stump and roots may catch under the front of the bulldozer. Clean out accumulated debris in the bulldozer's belly pan often to prevent fires.

Front-end Loaders. For smaller areas, where bulldozers are too big and cumbersome, clearing and grubbing can be accomplished using front-end loaders with a clamshell bucket. The clamshell bucket provides versatility for cutting and removing brush and vegetation. You can use the front cutting edge to cut and stockpile the material and use the clamshell to pick up debris and load it on haul vehicles. The front-end loader with clamshell bucket can also be used to pick up and remove saplings and small trees.

To perform this task, follow these steps:

Step 1: Conduct a job site visit

Use this visit to look at the area that needs to be cleared. Think about the construction equipment and materials you will need to accomplish the job. If the boundaries of the area are not already laid out, take time to do so now.

Step 2: Develop a project checklist

Write down details about the job while you are on site. This includes construction equipment needed for clearing, utilities in the area that need to be worked around, and any other information to make it easier to accomplish the job. Once complete return to the shop and refer to the checklist. Make sure nothing is forgotten so you do not have to stop work and return to the shop for additional items or equipment left behind.

Step 3: Clear the area

Ensure you are wearing appropriate personal protective equipment and using each piece of equipment properly. Using the appropriate equipment for the size of the area and type of material you are clearing, remove all trees, brush and rocks.

Step 4: Clean and park equipment

After each job, ensure that you clean and refuel each piece of construction equipment that was used. If there are any mechanical problems that developed while using the equipment make sure you identify the problem to vehicle maintenance and your supervisor. Properly park each piece of equipment in a safe and effective manner.

Review Questions
for
Clear Area Using:

Construction Equipment

Question	Answer
1. What equipment is typically used to clear large areas of vegetation, brush, trees and rocks?	a. Bulldozer b. Backhoe c. Skid steer loader d. Front-end loader
2. How should you remove medium size trees (12 to 18 inches in diameter) with a bulldozer?	a. Blade on ground, cut off even with soil b. Blade raised high, push tree over c. Blade raised high, push tree over and back up to prevent roots from lifting the bulldozer d. Back drag so the rear of bulldozer knocks down trees and the blade breaks off the limbs
3. The bulldozer should use the _____ step process to remove large trees (12 – 30 inch diameter).	a. 1 b. 2 c. 3 d. 4

CLEAR AREA USING:

CONSTRUCTION EQUIPMENT

Performance Checklist		
Step	**Yes**	**No**
1. Conducted job site visit and identified appropriate equipment to use for clearing area?		
2. Developed project checklist?		
3. Cleared area of vegetation, brush, trees, and rocks utilizing appropriate personal protective equipment and correct equipment?		
4. Properly cleaned and parked equipment?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

GENERAL PAVEMENT FUNCTIONS

MODULE 23 **AFQTP UNIT 1**

EXCAVATE AREA USING:

HAND TOOLS (23.1.3.1.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training if equipment is available. It is to be used in conjunction with these for training purposes only.

EXCAVATE AREA USING:

HAND TOOLS

Task Training Guide

STS Reference Number/Title:	23.1.3.1. Hand Tools
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Hand Tools (Depending on size and scope of project) • Personal Safety Equipment • General Tool Kit
Learning Objective:	• The trainee will be able to properly clear an area using hand tools.
Samples of Behavior:	• The trainee will clear an area using hand tools
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

EXCAVATE AREA USING:

HAND TOOLS

Background: The excavation of an area, regardless of size, requires the complete removal of all organic or "A" horizon soils. These soils will not properly compact and retain moisture. If the foundation deforms when a load is applied, then pavement will bend and eventually break. The method you use to excavate the area depends on the size of the area. In small areas such as patios and sidewalks, you would use hand tools.

Common uses of hand tools There are numerous types of hand tools used when excavating. Probably the most common of these is the shovel. Shovels may be either square pointed or round pointed. The square point shovels are used mainly for moving and leveling loose material and the round-point shovel is used for loosening or digging soil. Other tools you should be familiar with are picks and mattocks that also loosen soils so they can be removed with shovels. Picks are typically used to loosen hard, dry material such as clay and mattocks, which have a wider blade than picks, are also used to loosen and remove clay but typically when the clay is moist not dry. One other tool commonly used is the garden rake. The rake is used to rake out debris but can also be used to level loose material. Always remember to select the right tool for the right job. This will save time, effort, and money.

To perform the task, follow these steps:

Step 1: Conduct a job site visit

Use this visit to look at the area that needs to be excavated. Think about the tools and materials you will need to accomplish the job. If the area is not already laid out with string line and stakes, take time to do this now.

Step 2: Develop a project checklist

Take the time to list all hand tools you will need to excavate the area. Once complete, return to the shop and refer to the checklist. Make sure nothing is forgotten so you do not have to stop work and return to the shop for additional items or equipment left behind.

Step 3: Excavate the area

Using the picks, mattocks, square point, and round point shovels, excavate the area to the desired depth or elevation. Ensure you are using each tool properly. Also make sure you wear the appropriate personal protective equipment. Remember all "A" Horizon soils must be removed. If you are doing a concrete project, also remember to excavate enough area on the sides to allow for the forms.

Step 4: Check excavation elevation

Continue excavation until desired elevation is obtained. Ensure excavation is deep enough to account not only for base course but any pavement that is going on top of the base course.

Step 5: Clean and store tools

After each job, use your checklist to collect all tools prior to cleaning and returning to the tool room. Store the tools in the correct place in the tool room. This helps to keep the tool room clean and organized. If a tool is broken either repair or replace that tool.

Review Questions
for

Excavate Area Using:
Hand Tools

Question	Answer
1. What determines whether a project should be excavated by hand or by using equipment?	a. Size b. Budget c. Weather d. Geographical location
2. Which hand tool is used for moving and leveling loose soil?	a. Round point shovel b. Square point shovel c. Mattocks d. Pick
3. What hand tool is used to loosen dry, hard material such as clay?	a. Pick b. Rake c. Mattock d. Square point shovel
4. The excavation must be deep enough to allow for what two factors?	a. Base course and pavement thickness b. Base course and pavement type c. Drainage and pavement type d. Base course and drainage

EXCAVATE AREA USING:

HAND TOOLS

Performance Checklist		
Step	**Yes**	**No**
1. Conducted job site visit and identified appropriate tools to use for clearing area?		
2. Developed project checklist?		
3. Cleared area of vegetation, brush, trees, and rocks utilizing proper personal protective equipment and correct tools?		
4. Properly cleaned and returned tools to the correct location?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

GENERAL PAVEMENT FUNCTIONS

MODULE 23 **AFQTP UNIT 1**

EXCAVATE AREA USING:

CONSTRUCTION EQUIPMENT (23.1.3.2.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training if equipment is available. It is to be used in conjunction with these for training purposes only.

EXCAVATE AREA USING:

CONSTRUCTION EQUIPMENT

Task Training Guide

STS Reference Number/Title:	23.1.3.2. Construction Equipment
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Assorted Hand Tools • Assorted Heavy Equipment • Personal Safety Equipment
Learning Objective:	• The trainee will be able to properly excavate an area using construction equipment
Samples of Behavior:	• The trainee will excavate an area using construction equipment
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

EXCAVATE AREA USING:

CONSTRUCTION EQUIPMENT

Background: The excavation of an area, regardless of size, will require complete removal of all organic or "A" horizon soils. These soils will not properly compact and retain moisture. If the foundation deforms when a load is applied, the pavement will bend and eventually break. The method used to excavate the area will be determined by the size of the area. In small areas such as patios and sidewalks, you would use hand tools. In large areas such as parking lots or streets, you would use large equipment such as graders, loaders, or bulldozers. It doesn't take a very large job to justify using equipment to clear and excavate the area. Use the equipment to your advantage.

Common uses of construction equipment: Skid Steer Loaders are ideal for small to medium size projects requiring light excavation, such as a sidewalk or patio project. Front-end Loaders are also used for light to medium excavation. They are better suited for medium to large projects. On small projects, there may not be enough room to accommodate the size and turning radius of the loader. Backhoes are well suited for deep excavation. Using the back bucket you can dig several inches or several feet. The front bucket on the backhoe is only for light excavation. Bulldozers are used for heavy excavation over large areas. They have tremendous pushing power for large amounts of earth. Finally, the grader can also be used to excavate. Typically, the grader is used to cut off the top surface of organic material over large areas. It is also used to level and slope areas according to desired plans.

To perform the tasks, follow these steps:

Step 1: Conduct a job site visit

Use this visit to look at the area that needs to be excavated. Think about the construction equipment you need to accomplish the job. If the area is not already laid out with string line and stakes, take time to do this now.

Step 2: Develop a project checklist

Write down details about the job while you are on site. This includes construction equipment needed for excavating the area and any other information to make it easier to accomplish the job. This will help you remember what you equipment you need when you go back to the shop to get your tools and equipment. Once complete return to the shop and refer to the checklist. Make sure nothing is forgotten so you do not have to stop work and return to the shop for additional items or equipment left behind.

Step 3: Excavate the area

Using the appropriate equipment for the size of the area, excavate the area to the desired depth or elevation ensuring you are using each piece of equipment properly. Also make sure you wear the appropriate personal protective equipment. Remember all "A" Horizon soils must be removed. If you are doing a concrete project, also remember to excavate enough area on the sides to allow for the forms.

Step 4: Check excavation elevation

Continue excavation until the desired elevation is obtained. Ensure excavation is deep enough to account not only for base course but any pavement that is going on top of the base course.

Step 5: Clean and park equipment

After each job, ensure you clean and refuel each piece of construction equipment that was used. If there are any mechanical problems that developed while using the equipment make sure you identify the problem to vehicle maintenance and your supervisor. Properly park each piece of equipment in a safe and effective manner.

Review Questions
for

Excavate Area using:
Construction Equipment

Question	Answer
1. Skid Steer Loaders are ideal for _____ excavation in small to medium size projects.	a. Light b. Light to medium c. Medium d. Medium to heavy
2. What equipment is better suited for light to medium excavation in medium to large projects?	a. Backhoe b. Bulldozer c. Skid steer loader d. Front-end loader
3. What equipment is used for deep excavation?	a. Backhoe b. Trencher c. Skid steer loader d. Front-end loader
4. The excavation must be deep enough to allow for what two factors?	a. Base course and pavement thickness b. Base course and pavement type c. Drainage and pavement type d. Base course and drainage

EXCAVATE AREA USING:

CONSTRUCTION EQUIPMENT

Performance Checklist		
Step	**Yes**	**No**
1. Conducted job site visit and identified appropriate equipment to use?		
2. Developed a project checklist?		
3. Excavated area utilizing proper personal protective equipment and construction equipment for the job?		
4. Checked excavated area for desired elevation?		
5. Properly cleaned and parked equipment?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

GENERAL PAVEMENT FUNCTIONS

MODULE 23 **AFQTP UNIT 1**

PREPARE SUBGRADE

STABILIZE (23.1.4.1.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training if equipment is available. It is to be used in conjunction with these for training purposes only.

PREPARE SUBGRADE:

STABILIZE

Task Training Guide

STS Reference Number/Title:	23.1.4.1. Stabilize
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Soil, lime or Portland cement • Mixing Equipment • Personal Safety Equipment • General tool kit
Learning Objective:	• The trainee will be able to properly stabilize an area using mechanical and/or chemical means.
Samples of Behavior:	• The trainee will mechanically and/or chemically stabilize an area.
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

PREPARE SUBGRADE: STABILIZE

Background: Soil stabilization is the process that alters any property of soil to improve its engineering characteristics. The purposes of soil stabilization are to increase the strength and the drainage qualities of the soil. Soil stabilization is most frequently used to improve existing subgrade soil, so its load bearing capacity is sufficiently increased. Thus, the thickness of the base course may be reduced, or the need for a separate base course of imported materials may be eliminated.

There are two general types of stabilization, mechanical and chemical. Mechanical stabilization is accomplished in some cases by mixing finer graded soils with coarse sand and gravel. This type of stabilization is normally used to increase the drainage qualities of the soil. The essentials for good mechanical stabilization are proper gradation of coarse-grained materials, a good binder soil, and proper control of the moisture content. Mechanical stabilization would help if there is a large amount of clay in the subgrade. Since we know that clay drains very poorly, we must blend the clay with coarse sand. This mixture will increase the drainage qualities of the soil. A chemically stabilized soil is one that has been mixed with cement, lime, or a bituminous material. The result is stabilization by cementing action.

Soil-cement stabilization consists of mixing silt, Portland cement, and water in definite proportions, then compacting the mixture to a prescribed density. Thorough pulverization of the soil and thorough mixing with cement and water is essential to success. Soil-lime stabilization consists of mixing clay and lime. The plasticity of the clay is reduced, making the soil easier to pulverize, mix, and compact. Lime is also valuable as a drying agent in subgrades, where a high water table is likely to cause saturation of the subgrade. The lime must be thoroughly mixed with the soil. Bituminous soil-stabilization is the process by which a controlled amount of bituminous material is thoroughly mixed with an existing granular soil or aggregate material to form a stable base or wearing surface. The bituminous material may be either asphalt or tar, however, asphalt's are more frequently used.

When soils are being stabilized, they must be thoroughly mixed and spread evenly before compaction. Two methods of mixing soils and stabilization agents are common. Mixing with a grader is a satisfactory method of mixing soils together. The rotary-tiller mixer is commonly used in chemical stabilization, as it mixes the materials in place.

To perform the tasks, follow these steps:

Step 1: Determine stabilization method

Decide whether you are going to use mechanical or chemical stabilization. Mechanical stabilization is accomplished by mixing unlike soils. This means adding soil to soil and involves the adding and mixing of gravel, sand, silt, and clay as required by the existing soil. This is normally done to increase drainage qualities. Chemical stabilization would include adding Portland cement to silt, adding lime to clay, and adding bituminous material to granular or crumbly soil. This increases the strength of the soil. Ensure you use a respirator when applying chemicals for stabilization.

Step2: Acquire the appropriate materials

Load and haul soil to the site if using mechanical stabilization. Determine how much chemical is needed for stabilization. Take the correct amount to the job site.

Step 3: Mix the materials

No matter which method you use, thoroughly mix and spread the materials throughout the entire area. The grader and rotary tiller are good types of equipment for mixing materials.

Step 4: Clean and store mixing equipment

Take time to thoroughly wash off the equipment you use to mix the materials, especially if you used chemicals.

Review Questions
for

Prepare Sub-grade:
Stabilize

Question	Answer
1. What type of chemical would you add to granular, crumbly soil?	a. Lime b. Portland cement c. Sodium calciumate d. Bituminous materials
2. Lime is used to stabilize _____.	a. silt b. clay c. sand d. gravel
3. What are the two types of stabilization?	a. Intrensive and intensive b. Mechanical and chemical c. Mechanical and intrensive d. Consolidation and compaction
4. Mechanical stabilization means mixing _____ with _____.	a. soil; soil b. lime; silt c. cement; clay d. bitumen; sand

PREPARE SUBGRADE:

STABILIZE

Performance Checklist		
Step	**Yes**	**No**
1. Determined appropriate stabilization method?		
2. Acquired correct materials?		
3. Spread and mixed materials?		
4. Cleaned and stored mixing material?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

GENERAL PAVEMENT FUNCTIONS

MODULE 23 **AFQTP UNIT 1**

PREPARE SUBGRADE

COMPACTION (23.1.4.2.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training if equipment is available. It is to be used in conjunction with these for training purposes only.

PREPARE SUBGRADE:

COMPACTION

Task Training Guide

STS Reference Number/Title:	23.1.4.2. Compaction
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Compaction Equipment • Personal Safety Equipment • General Tool Kit
Learning Objective:	• The trainee will be able to properly compact an area that has been mechanically or chemically stabilized
Samples of Behavior:	• The trainee will compact an area that has been mechanically or chemically stabilized
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

PREPARE SUBGRADE:

COMPACTION

Background: One of the basic construction procedures involved in building subgrade and base courses for roads and airfield pavements, embankments, earth-fill dams, and similar structures is compaction. Compaction is the process of increasing the density of the soil by mechanical means. Field compaction is accomplished by rolling or by the passage of construction equipment over the material.

The purpose of compaction is to increase the density of a soil. The amount of compaction a soil must undergo depends upon the amount of strength that must be built into a pavement. The weight and traffic to which it will be subjected determine pavement strength required. Compaction helps prevent shearing and settlement when loads are applied. Consider the type and size of equipment to be used. It would be very time consuming to compact a large area with small powered equipment. On the other hand, a large bulky roller would not fit into a small area. The size of the construction area will determine the size of the compaction equipment.

In small areas, you would use vibratory plate compactors, which should be used only on stable material. Ensure that you overlap each pass by one half of the compactor width. In large areas, rollers are normally used. The type of soil in the subgrade determines type of roller. Pneumatic-tired rollers are used for all types of soil and are especially useful for the final compaction of the upper 6" of sub-grades and base courses. Steel-wheel rollers are used for the final rolling of subgrades and rolling of base courses to a smooth surface and especially used for compacting granular soils with little or no fines such as sand and gravel mixtures. Sheepsfoot rollers compact from the bottom up, so they are best to use on clay type soils. When using the sheep's-foot roller the lift thickness for each layer of soil you compacting should not exceed 6 inches in depth. For example, if an area requires 10 inches of material to be stabilized and compacted, then you would need to compact in layers. One layer approximately 6 inch in depth and the other 4 inches in depth. Compacting in layers helps achieve maximum compaction.

In order to achieve maximum compaction it is important to add water to the soil. When compacting the subgrade with either large or small equipment, you should ensure you have optimum moisture content. This means you should always have the right amount of moisture in the soil. If the soil is too dry, it will tend to shear (or tear) under the weight of the roller or the vibration of the tampers. If it is too wet, it will stick to the roller drums, tires, or plates of the compaction equipment. This causes the forward motion of the tamper to stop and rollers to lose their compaction ability because of the mucky conditions. You can correct these conditions by re-wetting dry soils and aerating wet soils. Ensure you continue compaction until the desired density is obtained.

To perform the tasks, follow these steps:

Step 1: Determine compaction equipment

Size of the area must be a consideration. Small areas require smaller equipment while larger areas will accommodate large rollers. Sometimes your selection is limited by what equipment you have available. If the correct equipment is unavailable, you may have to use the equipment on hand. The better option is to rent the correct equipment to do the job properly.

Step 2: Compact the materials

Purpose is to increase the density of the soil. Size of the area will determine the size of the compaction equipment. With all methods of compacting, you continue compaction until the desired density is obtained.

Review Questions
for

Prepare Sub-grade:
Compaction

Question	Answer
1. The purpose of compaction is to increase the subgrades _____.	a. thickness b. moisture c. density d. shape
2. Compaction prevents shearing and _____ when loads are applied.	a. settlement b. upheaval c. tearing d. undercutting
3. Which roller is best used on granular soils with little or no fine such as sand and gravel mixtures?	a. Sheepsfoot b. Pneumatic c. Steel Wheel d. Vibratory Plate
4. Which roller is best used for clay soils?	a. Sheepsfoot b. Pneumatic c. Steel Wheel d. Vibratory Plate

PREPARE SUBGRADE:

COMPACTION

Performance Checklist		
Step	**Yes**	**No**
1. Determined appropriate compaction equipment?		
2. Compacted the subgrade ensuring equipment was operated correctly and safely?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

GENERAL PAVEMENT FUNCTIONS

MODULE 23 **AFQTP UNIT 1**

PREPARE BASE COURSE

PLACE (23.1.5.1.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training if equipment is available. It is to be used in conjunction with these for training purposes only.

PREPARE BASE COURSE

PLACE

Task Training Guide

STS Reference Number/Title:	23.1.5.1. Place
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Hand Tools • Construction Equipment • Personal Safety Equipment • General Tool Kit
Learning Objective:	• The trainee will be able to properly place base course
Samples of Behavior:	• The trainee will place base course
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

PREPARE BASE COURSE:

PLACE

Background: The purpose of a base course is to provide a uniform distribution of the wheel load so it will not exceed the strength of the subgrade and to provide adequate drainage. When the subgrade strength is low, the stress must be reduced to a low value and a substantial thickness of base is needed. Where the subgrade strength is higher, a lesser thickness will provide adequate distribution. Since the stresses in the base course are always higher than in the subgrade, it stands to reason the base course must have a high strength. Building higher strength into the subgrade may reduce required thickness of base

Give careful attention to the selection of materials for base courses and to their construction. The materials should be well-graded, angular in shape, and uniformly compacted to its maximum density. A good blend for a high-density base course is 50 percent, well-graded gravel; 40 percent, well-graded sand; and 10 percent, slightly plastic silt. This is the best blend to use and is relatively easy to place and spread.

The placing and spreading of the base course material on a prepared subgrade may begin at the point nearest the source or at the point farthest from the source. The material is then placed progressively away from or toward the source, respectively. The advantage of working from the point nearest the source is that the hauling vehicles can be routed over the spread material, which assists in compacting the base and avoids cutting up the subgrade. Advantages of working from the point farthest from the source are that the hauling equipment will further compact the subgrade, reveal any weak spots in the subgrade so they can be corrected promptly, and interfere less with the movement of spreading and compacting equipment. Probably the biggest problem encountered when placing and spreading base course materials is segregation. This occurs when the material is dropped from too great a height. It also may occur when you move material with shovels or rakes. When placing or spreading base course material, be careful to prevent segregation of the mix.

To perform the tasks, follow these steps:

Step 1: Determine amount of base course needed

Calculate the amount of material you will need. Remember to add a little extra to compensate for low spots in the subgrade.

Step 2: Dump and spread base course materials

Be flexible in your plan to dump and spread. You can dump in a pile and use other equipment to spread the material. You can spread dump as you go. The method you use is relative to the need to get it completed. Remember to prevent segregation of the materials.

Review Questions
for

Prepare Base Course:
Place

Question	Answer
1. A good base course is made up of _____.	a. 50% well graded gravel, 40% well graded sand, and 10% slightly plastic silt b. 50% open graded gravel, 40% slightly plastic silt, and 10% well-graded sand c. 50% gap graded gravel, 40% well-graded silt, and 10% slightly plastic sand d. 50% well graded gravel, 40% open graded sand, and 10% well graded silt
2. If sub-grade strength is low, then the base course must be _____.	a. Weaker than the sub-grade b. Stronger than the sub-grade c. The same strength as the sub-grade d. None of the above
3. When placing the base course, try to prevent _____.	a. settlement b. segregation c. shearing d. sinking

PREPARE BASE COURSE:

PLACE

Performance Checklist		
Step	**Yes**	**No**
1. Determined the correct amount of base course material?		
2. Placed base course material and spread as required?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

GENERAL PAVEMENT FUNCTIONS

MODULE 23 **AFQTP UNIT 1**

PREPARE BASE COURSE:

COMPACT (23.1.5.2.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training if equipment is available. It is to be used in conjunction with these for training purposes only.

PREPARE BASE COURSE:

COMPACT

Task Training Guide

STS Reference Number/Title:	23.1.5.2. Compact
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Compaction Equipment • Personal Safety Equipment • General Tool Kit
Learning Objective:	• The trainee will be able to properly compact base course
Samples of Behavior:	• The trainee will compact base course
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

PREPARE BASE COURSE:

COMPACT

Background: Base course compaction must produce a uniformly dense layer conforming in every way to specification requirements. The thickness of the layers of material should not exceed that which can be compacted to the required density. This typically depends on the size of the equipment you are using. For smaller compaction equipment, base course materials should be compacted in layers of 2 – 3 inches. For larger compaction equipment the thickness of layers can go up to six inches. In areas that are inaccessible to the rollers, small tampers and compactors will be utilized. In this case, layer thickness must be three inches or less.

When compacting base course, optimum moisture content should be maintained during compaction procedures. Equipment and methods must be adjusted on each job to suit the characteristics of the base material since thorough compaction is important in developing maximum stability. The compaction operation will continue until the desired density is obtained.

The base course must be sufficiently compacted to prevent consolidation (settlement) under traffic. The support foundation must be capable of withstanding the wheel loads for which it was designed. After the base course is compacted, final roll it to furnish a tight, water-shedding surface free of roller marks that may prevent runoff. The final rolling is best accomplished using steel-wheel rollers. After the final compaction, the height of the compacted base course must be at the proper elevation.

To perform the tasks, follow these steps:

Step 1: Determine compaction equipment

Size of the area must be a consideration. Small areas require smaller equipment while larger areas will accommodate large rollers. Sometimes your selection is limited by what equipment you have available. If the correct equipment is unavailable, you may have to use the equipment on hand. The better option is to rent the correct equipment to do the job properly.

Step 2: Compact the materials

Purpose is to increase the density of the soil. Size of the area will determine the size of the compaction equipment. With all methods of compacting, you continue compaction until the desired density is obtained.

Step 3: Final roll of the base course

Use a steel wheel roller to get a smooth, tight water-shedding surface. Ensure the area is free from roller marks so water will not get trapped on the surface.

Review Questions
for

Prepare Base Course:
Compact

Question	Answer
1. When using small compaction equipment the thickness of each layer should be _____.	a. 6 inches or less b. 5 inches or less c. 4 inches or less d. 3 inches or less
2. When using large compaction equipment the thickness of each can be as much as _____ inches.	a. 3 b. 4 c. 5 d. 6
3. The base course must be compacted to a _____.	a. loose water shedding surface b. tight water shedding surface c. tight well draining surface d. dense gap graded surface

PREPARE BASE COURSE:

PLACE

Performance Checklist		
Step	**Yes**	**No**
1. Determined appropriate compaction equipment?		
2. Compacted the material?		
3. Conducted final roll of the base course?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

GENERAL PAVEMENT FUNCTIONS

MODULE 23 **AFQTP UNIT 1**

COMPUTE MATERIALS REQUIRED (23.1.6.)

COMPUTE MATERIALS REQUIRED

Task Training Guide

STS Reference Number/Title:	23.1.6. Compute Materials Required
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Calculator • Paper • Pen/Pencil
Learning Objective:	• The trainee will be able to properly calculate base course, asphalt, and concrete materials.
Samples of Behavior:	• The trainee will provide answers to calculation scenarios.
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

COMPUTE MATERIALS REQUIRED

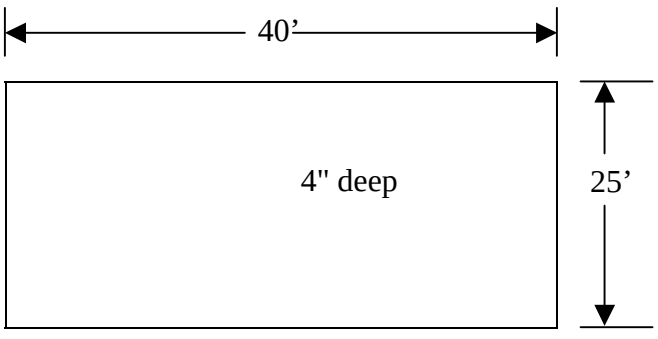
Background: Computing for concrete and base course requires different formulas. Computing for square or rectangular areas also requires different calculations.

- **Computing for Volume.** When computing for the amount of base course or concrete, you would need to determine the volume in cubic feet. Volume is defined as the three-dimensional space an object occupies as measured in cubic feet. To compute the volume of a square or rectangle, you would simply multiply the length x width x depth (L x W x D). Let's say we are going to build a patio that will measure 12 feet long by 10 feet wide and 4 inches deep. First, we must convert the inches into feet by dividing 4 by 12 that gives us .3333333'. Round this number to the nearest hundredth = .33'. Round numbers at the hundredth column down if it's less then 5 and up if it's 5 or more. Now, multiply 12' x 10' x .33' which gives us 39.6 cubic feet.

- **Computing for Base Course.** Base course is ordered by the ton. The weight of base course can vary, but generally there will 20 cubic feet of base course per ton. First, use the formula L x W x D to compute the volume. For example an area is 12' x 10' x 4" = 39.6 cubic feet. Now, divide the volume by 20 for the total amount of base course in tons you would need to order. Your equation would be 10 x 10 x 33 ÷ 20 = 1.98 or 2 tons of base course. Round up to the nearest ton required.

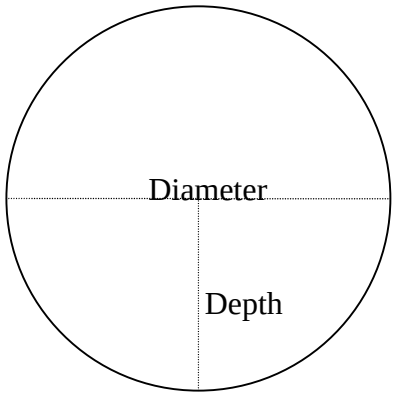
- **Computing Concrete.** Concrete is ordered by the cubic yard. To calculate the required number of cubic yards, we simply divide the volume by 27. We do this because there are 27 cubic feet in one cubic yard. The equation would be L x W x D ÷ 27 = cubic yards. Calculate for a rectangle measuring 40' x 25' x .33' ÷ 27 = 12.222222 cubic yards of concrete.

Often you will encounter low spots in the base course or spill the concrete when placing it. Therefore, we may need a little more concrete to compensate. Once we have computed our total cubic yards required for a job, it is best to order a little extra. We can calculate the excess needed by adding 5% to the total cubic yards. This will give us adequate material to allow for the low spots and spillage. Your new formula would be L x W x D ÷ 27 +5% = cubic yards of concrete plus 5%.



40 x 25 x .33 ÷ 27 +5% = 12.833333 or 13 cu. yd. of concrete. Round up to the nearest cubic yard needed.

- **Compute Volume.** Let's suppose our area is shaped like a circle. The formula for computing the volume of a circle is Pi, x the radius squared x the depth. (Volume = Pi r^2 x D). The number 3.14 represent pi. The radius of a circle is half of the diameter. To obtain the radius, divide the diameter in half. To square the radius, simply multiply the radius times its self. An example of this would be a circle with a diameter of 30 feet and a depth of 3 inches. First, convert the inches into feet by dividing 3 by 12, which gives us .25. Now multiply 3.14 x 15 x15 x .25, for a total of 176.625 cubic feet.



Diameter = 30'
Depth = 3"

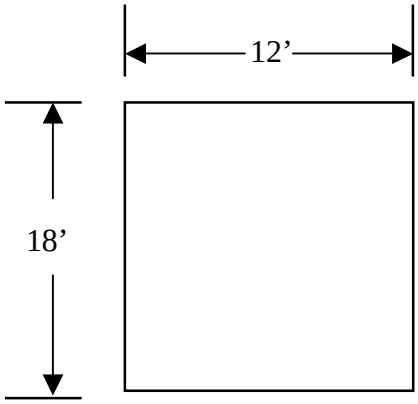
- **Compute Base Course.** Remember base course is ordered by the ton. We simply divide the volume by 20 cubic feet to get the number of tons required. An example of this would be a circle 14 feet in diameter and 3 inches deep. Your equation would be (Pi x r^2 x D ÷ 20) 3.14 x 7 x 7 x .25 ÷ 20 = 1.92325 or 2 tons. Round up to the nearest ton needed.

- **Compute Concrete.** Concrete is ordered by the cubic yard. We simply divide the volume by 27 to get the cubic yards required. An example of this would be a circle 18 feet in diameter and 4 inches in depth. Your equation would be (Pi x r^2 x D ÷ 27) 3.14 x 9 x 9 x .33 ÷ 27 = 3.1086 cubic yards. Remember to add 5% for low spots in the base course and spillage. The amount of concrete required plus 1.05 (5%) is 3.14 x 9 x 9 x .33 ÷ 27 + 5% = 3.26403 or 4 cubic yards. Round up to the nearest cubic yard needed.

- **Compute Prime Coat and Tack Coat.** Prime coat and tack coats are both ordered by the gallon. To calculate the amount you need, you have to multiply the total square yards of the area to be sprayed by the application rate specified for the prime or tack coat. The application rate for prime coat varies from .10 to .25 gallons per square yard and tack coat varies from .05 to .15 gallons per square yard. After determining the area in square feet, divide by 9 to get the total square yards (there are 9 square feet in one square yard). Then multiply the total square yards by the rate of application to get the total gallons of prime or tack coat required. Round this figure up to the nearest whole gallon for the amount of material needed.

Example:

Find the Area
Length x Width
18' x 12' = 216 sq. ft.

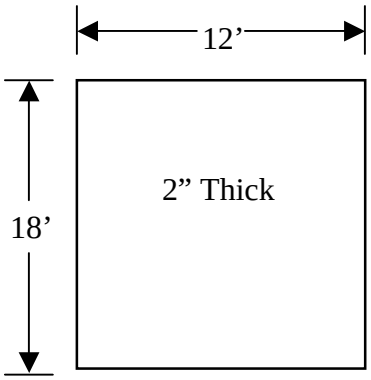


Find the Amount of Prime/Tack Coat Required.
Length x Width ÷ 9 x application rate = gallons required
18' x 12' ÷ 9 x .05 = 1.2 gallons required
Round up to the nearest gallon needed = 2 gallons needed

- **Compute Asphalt.** Now you are ready to figure the amount of asphalt needed for the job. After you have determined the area in square feet, multiply the area x depth to obtain the volume in cubic feet. Don't forget to convert inches into feet prior to making any other calculations. Since our bituminous paving materials are ordered in tons instead of cubic yards, you must know how much the materials weighs. There are several methods of calculating the weight. However, we will be using one that has been proven to be the easiest. This method is to multiply the total number of cubic feet x 140 pounds when ordering hot-mix and 90 when ordering cold-mix.

The numbers (140 and 90) represent the approximate weight of one cubic foot of compacted hot or cold mix asphalt. Cold-mix doesn't compact as tightly as hot-mix does so it will weigh less. Since there are 2000 pounds in one ton, divide the total weight of the material by 2000, giving you the total number of tons required. Again you need to add in an additional 5% to allow for low spots in the base course and waste. Asphalt is ordered by the ton, so you need to round this figure up to the nearest whole ton for the amount of asphalt needed.

Find the Volume
Length x Width x Depth
18' x 12' x .17' = 36.72 cu. ft.



Find the Amount of Asphalt Required.
Multiply the cu. ft. by either 140 or 90 depending on the type of asphalt being used.
Divide by 1 ton (2000) to get the amount of asphalt needed in tons.

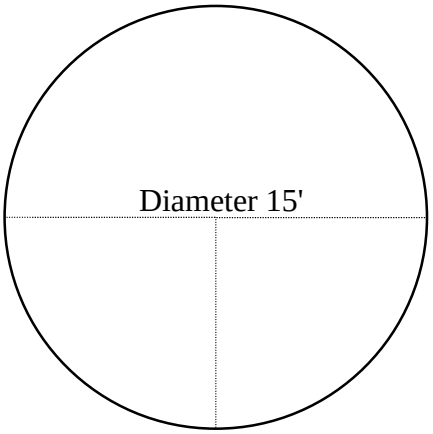
Hot mix: 36.72 x 140 ÷ 2000 = 2.57 tons
Cold mix: 36.72 x 90 ÷ 2000 = 1.65 tons

Add 5% to allow for low spots in the base course and for waste.
Hot mix: 2.57 + 5% = 2.6985 tons required
Cold mix: 1.65 + 5% = 1.7325 tons required

Round up to the nearest ton needed.

Hot mix: 3 tons
Cold mix: 2 tons

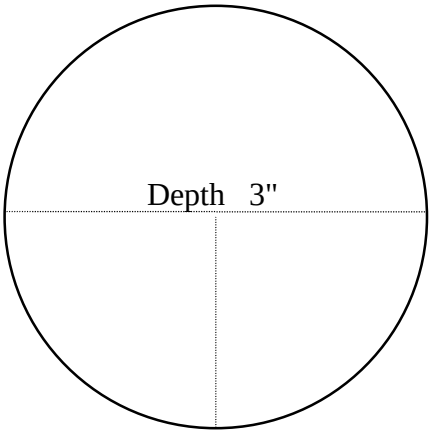
Find the Area
Pi r2
3.14 x 7.5 x 7.5 = 176.625 sq. ft.



Find the Amount of Prime/Tack Coat Required.
Pi r2 ÷ 9 x application rate = gallons required
3.14 x 7.5 x 7.5 ÷ 9 x .25 = 4.90625 gallons required

Round up to the nearest gallon = 5 gallons needed

Find the Volume.
Pi r2 x Depth
3.14 x 7.5 x 7.5 x .25 = 44.15625 cu. ft.



Find the Amount of Asphalt Required.
Multiply the cu. ft. by either 140 or 90 depending on the type of asphalt being used.
Divide by 1 ton (2000) to get the amount of asphalt required in tons.

Hot mix:	44.15625 x 140 ÷ 2000 = 3.09 tons
Cold mix:	44.15625 x 90 ÷ 2000 = 1.98 tons

Add 5% to allow for low spots in the base course and for waste.

Hot mix:	3.09 + 5% = 3.2454843 tons required
Cold mix:	1.98 + 5% = 2.0863827 tons required

Round up to the nearest ton needed

Hot mix:	4 tons
Cold mix:	3 tons

Review Questions
for
Compute Materials Required

Question	Answer
1. What is the application rate for prime coat?	a. .05 to .15 gallons per square yard b. .10 to .25 gallons per square yard c. .05 to .15 gallons per square foot d. .10 to .25 gallons per square foot
2. How much does one cubic foot of cold mix weigh?	a. 20 pounds b. 90 pounds c. 140 pounds d. 2000 pounds
3. Why do you divide the total weight of asphalt by 2000?	a. To break the calculations down into workable numbers b. To account for the thickness c. To convert pounds to tons d. To convert tons to pounds
4. How do you convert inches into a decimal part of a foot?	a. Divide by 3.14 b. Multiply by 3.14 c. Divide by 12 d. Multiply by 12
5. What is the radius of a circle?	a. Half the diameter b. The area inside a circle c. The center point of the circle d. The measurement around the outside of the circle
6. How is base course ordered?	a. By the square yard b. By the cubic yard c. By the pound d. By the ton
7. How many cubic feet are in one cubic yard?	a. 9 b. 10 c. 12 d. 27

SAMPLE CALCULATIONS

Give the trainee a calculator and have them figure the following problems with no assistance.

Base Course.

1. How many tons of base course will be required for the following projects?

   a. Length 50', width 40', and a depth of 6"
   Base Course needed _____.

   b. Length 600', width 4', and a depth of 3"
   Base Course needed _____.

   c. Diameter 20' depth 8"
   Base Course needed _____.

Concrete.

2. How many cubic yards of concrete will be required to complete the following projects? Your answers should include the amount needed to complete the project including the additional 5%.

   a. Length 19' width 13' depth 7"
   Concrete needed _____.

   b. Length 325' width 4' depth 4"
   Concrete needed _____.

   c. Diameter 120' depth 9"
   Concrete needed _____.

Asphalt.

3. How much asphalt is needed to complete a project that is 65' long, 30' wide, and 4" deep?

    a. Amount of prime coat at .2 application rate _____

    b. Amount of hot mix required _____

    c. Amount of hot mix required plus 5% _____

    d. Amount of cold mix required _____

    e. Amount of cold mix required plus 5% _____

4. How much asphalt is needed to complete a circular project with a diameter of 100' and a depth of 5"?

    a. Amount of tack coat at .09 application rate _____

    b. Amount of hot mix required _____

    c. Amount of hot mix required plus 5% _____

    d. Amount of cold mix required _____

    e. Amount of cold mix required plus 5% _____

COMPUTE MATERIALS REQUIRED

Performance Checklist		
Step	**Yes**	**No**
1. Calculated Base Course?		
2. Calculated Concrete?		
3. Calculated Prime and Tack Coat?		
4. Calculated Asphalt?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

RIGID PAVEMENT

MODULE 23 **AFQTP UNIT 2**

CONSTRUCT RIGID PAVEMENT:

INSTALL FORMS (23.2.2.1.)

CONSTRUCT RIGID PAVEMENT:

INSTALL FORMS

Task Training Guide

STS Reference Number/Title:	23.2.2.1. Install Forms
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Forms • Tool bag • Personal Protective Equipment
Learning Objective:	• The trainee will be able to properly install concrete forms
Samples of Behavior:	• The trainee will install concrete forms
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

INSTALL FORMS

Background: Concrete forms serve three purposes. They contain the concrete, provide a track for form riding equipment, and aid in curing. Forms may be constructed of either wood or metal. Use of wooden forms is generally restricted to small slabs. Metal forms are used for large slabs, long sidewalks, and driveways. Metal forms are used for pavement 4 inches or more in thickness.

Metal forms are 10 feet long and vary in height. All standard forms have three stake pockets with wedges to hold the forms firmly in position. Metal forms are convenient and reusable.

Wood forms are normally made from common lumber. These forms are erected or constructed on the job site. 2 x 4s or 2 x 6s turned up on edge can be cut to the desired lengths.

To perform the tasks, follow these steps:

Step 1: Line up forms

Line up the top inside edge of the form to the string line to ensure the proper elevation.

Step 2: Install stakes

For wooden forms, drive a stake at each end of the form, then go back and install stakes every two feet along the form. For metal forms, drive stakes through the end stake pockets and lock in place with the wedges. Then go back and install a stake in the center pocket.

Step 3: Final adjustments

Ensure the top inside edge of the form is barely touching the string. If the form is too high, lower it by tapping on the stakes not the form. If the form is too low, then loosen the wedges on the metal forms and re-adjust. For wooden forms, you may have to pull the nails and re-adjust. You may have to adjust the form to the string by packing the dirt at the side of the stake. If you want the form to move inward toward the string, hit the dirt on the outside of the stake with a hammer. If you want the form to move outward, hit the dirt on the inside of the stake.

HINT:
When installing forms, ensure the stakes do not extend above the forms. Also place soil behind the forms to prevent concrete from entering the stake pockets on metal forms and pushing out from under the forms.

Review Questions
For

Construct Rigid Pavement
Install Forms

Question	Answer
1. Why place soil behind the forms?	a. To prevent concrete from getting in the stake pockets b. To keep the sides of the pad from loosing heat c. To ensure proper elevation of the form d. To allow for drainage
2. How do you ensure proper elevation of a form?	a. By aligning the top outside edge of the form with the string line b. By aligning the top inside edge of the form with the string line c. By aligning the top of the form with the top of the stakes d. By placing soil behind the forms
3. What is the length of metal forms?	a. 10’ b. 8’ c. 6’ d. 4”

CONSTRUCT RIGID PAVEMENTS:

INSTALL FORMS

Performance Checklist		
Step	**Yes**	**No**
1. Lined up forms?		
2. Installed stakes?		
3. Made final adjustments to forms?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

RIGID PAVEMENT

MODULE 23 **AFQTP UNIT 2**

CONSTRUCT RIGID PAVEMENT:

INSTALL REINFORCING MATERIALS (23.2.2.2.)

CONSTRUCT RIGID PAVEMENT:

INSTALL REINFORCING MATERIALS

Task Training Guide

STS Reference Number/Title:	23.2.2.2. Install Reinforcing Materials
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Reinforcing Materials • Tool Bag • Personal Protective Equipment
Learning Objective:	• The trainee will be able to properly install reinforcing materials
Samples of Behavior:	• The trainee will install reinforcing materials
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

CONSTRUCT RIGID PAVEMENT:

INSTALL REINFORCING MATERIALS

Background: Reinforcement is the term used to describe the steel bars and small or large welded wire fabric positioned in concrete. Its purpose is to increase the tensile strength of the hardened concrete. Concrete has great strength in compression, that is, it can support great loads placed directly upon it. Steel bars or other metal reinforcement is required in concrete if it is to resist stresses or forces that tend to bend it or pull it apart. The compressive strength of concrete is about 10 times greater than its tensile strength. When metal reinforcement is used in concrete, the reinforcement withstands the tensile pull. The tensile strength can be made equal to or greater than the compressive strength depending on the amount of reinforcement used.

Many materials have been tried as reinforcement in concrete. Steel is the universally accepted and used. One important advantage of steel is that its contraction and expansion characteristics due to temperature changes are nearly the same as those of concrete.

Reinforcing steel can be purchased two ways, keep bars (called rebar) or as welded wire fabric. This material is used in concrete only where additional tensile strength is required. Concrete slabs that are not expected to withstand heavy loads do not normally require steel reinforcement. An example of a "non" load-bearing surface would be a sidewalk (except where they cross a driveway), a patio, or porch.

To perform the tasks, follow these steps:

Step 1: Cut steel

Begin by cutting the steel to the desired dimensions. You can use a hacksaw, bolt cutters, or a torch depending on the thickness and available equipment. Cut the steel so that it fits inside the forms without touching the forms.

Step 2: Bend steel

After the steel is cut, it may need to be bent to fit around obstacles or corners. Bend it by hand if the steel is small enough or heat it with a torch first to make it easier to bend. (Even though heating rebar with a torch is a common practice it is not the recommended method since heating and cooling of the metal changes the properties of the metal—use an approved rebar bending device when possible).

Step 3: Install steel

Chairs normally support the rebar. They are simply devices that hold the steel off the ground and allow at least 2" of concrete between the steel and the base course. If commercially produced chairs are not available, broken brick or any other suitably sized object can be used to support the steel. Rebar must be either welded or tied where it intersects other bars. Wire fabric is purchased in rolls of various widths and can be rolled out over the area as necessary. It should be placed on chairs to keep it up off the base course. If chairs are not used, the wire may be placed directly on the base course and pulled to the center of the concrete with a hook device rake while the concrete is still in a plastic state.

Review Questions
For

Construct Rigid Pavement
Install Reinforcing Materials

Question	Answer
1. What is the purpose of reinforcing steel?	a. To aid in concrete curing b. To reinforce the base course c. To increase the tensile strength of the hardened concrete d. To decrease the amount of concrete needed for the project
2. What are the types of reinforcing steel?	a. Rebar and welded wire fabric b. Angle iron and round stock c. Angle iron and rebar d. Hard and semi hard
3. When using wire mesh for reinforcement, how is it positioned in the pour area?	a. Using chairs or pulled to the center with a hook device b. After the concrete is in place and pushed down c. Flat on the bottom of the pad d. After floating

CONSTRUCT RIGID PAVEMENT:

INSTALL REINFORCING MATERIALS

Performance Checklist		
Step	**Yes**	**No**
1. Cut steel?		
2. Bent steel?		
3. Installed steel?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

RIGID PAVEMENT

MODULE 23 **AFQTP UNIT 2**

CONSTRUCT RIGID PAVEMENT:

PLACE (23.2.2.5.)

FABRICATE JOINTS (23.2.2.8)

FINISH (23.2.2.6.)

CURE (23.2.2.7.)

CONSTRUCT RIGID PAVEMENT:

PLACE / FABRICATE JOINTS / FINISH / CURE

Task Training Guide

STS Reference Number/Title:	23.2.2.5. Place 23.2.2.8. Fabricate Joints 23.2.2.6. Finish 23.2.2.7. Cure
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Bull float • Magnesium float • Hammer • Soft bristled broom • Edger • Jointer • Tool Bag • Personal Protective Equipment
Learning Objective:	• The trainee will be able to properly place, finish, cure, and fabricate joints in concrete
Samples of Behavior:	• The trainee will place, finish, cure, and fabricate joints in concrete
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

CONSTRUCT RIGID PAVEMENT

PLACE / FABRICATE JOINTS / FINISH / CURE

Background: Constructing a concrete project involves many different tasks. First you have to place the concrete in the forms. Then you finish it, fabricate joints, and cure it. Some of these tasks overlap. This means they are accomplished at the same time as other tasks. There are also some tasks that have to be accomplished after others. For example, you cannot finish the concrete until it has been placed, screeded, floated, edged, or jointed. In order to construct a quality project, you need to understand and be able to accomplish all the tasks associated with placing, finishing, fabricating joint, and curing the concrete.

PLACE CONCRETE Recheck the forms for proper alignment. This is especially important if the forms have been in place for several days. Next, moisten the area with water just prior to placing the concrete. The base course, forms, and reinforcement steel (if any) must be moistened. This is to stop the base course and the forms from drawing excess amounts of moisture out of the concrete mixture and to reduce the surface temperature of materials that may have been exposed to the sun for several hours. It is important to mention that these surfaces should not be saturated, only moistened. At this time you also want to oil the forms using either a form release agent or used motor oil. This prevents concrete from sticking to the forms.

Now you are ready to actually place the concrete. If the new concrete is going to butt against old concrete you need to install expansion material. This creates an expansion joint. Expansion material will relieve the compressive stresses that will occur as the concrete expands and contracts. You can purchase expansion material or use any compressible material, such as softwood, etc. Once the concrete is delivered, you want to place it in the area.

When placing concrete, do not allow concrete to free fall any further than absolutely necessary. Place the mix as dry as possible, adding only enough water to make it workable. Avoid long distance wheelbarrow trips as this causes coarse aggregates to settle to the bottom. Try to place the concrete as near as possible to its final resting-place.

As the concrete is being placed, the next step is to consolidate the mix. Consolidation eliminates stone pockets and large pockets of air. It creates a uniform plastic mass. Some of the most common tools for consolidating concrete are jitterbugs and vibrating screeds. Consolidating tools should be used sparingly otherwise the concrete will segregate.

After the concrete has been consolidated, it must be screeded. Screeding is done by laying a straight length of either wood (2" x 4", 2" x 6", etc.) or commercially purchased aluminum (2" x 4", 2" x 6", etc.) across parallel forms and moving in a sawing motion from one end of the job to the other. This removes excess concrete and leaves a level, but rough surface. Screeding may often be done two or more times after concrete is placed.

While screeding is taking place, one person should be assigned the duty of "tapping" the outside of the forms with a hammer. This will consolidate the edges of the slab and eliminate air pockets (honeycomb) between the form and slab sides.

After screeding is completed, the concrete should be floated as necessary with a wood or metal float. A bull float is used for large areas and a hand float is used for small areas. The hand float should be held flat on the concrete surface and moved with a slight sawing motion in a sweeping arc. This action will fill in holes, cut off high areas, embed the aggregate particles just beneath the surface and compact the mortar at the surface in preparation for additional finishing operations. Floating too much will work excessive amounts of cement/water paste to the surface and must be avoided. Excessive surface paste weakens the surface and can cause it to chip and break under little or no stress.

During floating of the concrete, you can also use the edging tool and place an edge on the concrete. This rounds off the edges of the concrete and makes it less likely to chip off later. It also enhances the appearance of the concrete.

To perform the tasks, follow these steps:

Step 1: Recheck form alignment

Step 2: Moisten the area

Step3: Oil the forms

Step 4: Install expansion material

Step 5: Place the concrete

Step 6: Consolidate the mix

Step 7: Tap the forms

Step 8: Screed the concrete

Step 9: Float the concrete

Step 10: Edge

FABRICATE JOINTS All plastic concrete contains more water than is required for the hydration of the cement. When this extra water starts to evaporate, the process of drying-shrinkage of the slab creates tensile stresses in the concrete. Providing joints can relieve these tensile stresses. If the stresses are not relieved, cracks will develop. Three basic types of joints, which are called expansion, construction, and contraction joints, are easy to make and should be used in flat work such as floors, slabs and walks.

- **Expansion Joint** As mentioned earlier, an expansion joint is one that has a compressible material placed between the new concrete and old. This helps relieve compressive stresses in the concrete caused by expansion and the force of pushing against the old immovable concrete.

- **Construction Joint** Any place where fresh concrete comes in direct contact against old concrete is considered to be a construction joint. Construction joints are normally where one day's pour ends and the next day's pour begins. There is no material of any kind placed between old and new concrete. This joint may or may not be readily visible. If it is visible, it should be only because of a slight color difference between the two slabs, not because of a difference in surface texture. To install a construction joint, simply cut a 2x4 piece of lumber and place it against the concrete.

- **Contraction Joint** Contraction joints (sometimes called dummy joints) relieve tensile stresses caused by pavement contraction and helps control cracking of the concrete. They consist of grooves formed in the surface of the concrete with a jointer or sawed with a concrete saw. These grooves reduce the pavement cross section at prescribed locations so the cracks will occur below the joint. These grooves are sawed to a depth of one-eight to one-fourth of the slab thickness and are ½ minimum to 5/8 maximum inch wide. Dummy joints may be formed into plastic concrete with a concrete saw 4 to 12 hours after finishing the pad or by using a tool called a jointer which forms a groove (not to exceed 1/4 slab thickness).

To perform this task, follow these steps:

Step 1: Determine the appropriate type of joint(s) to fabricate

Step2: Identify location for each joint

Measure the distances between each location. Make a small mark to identify where to install the joint.

Step 3: Obtain proper tool or material for the joint(s)

If making an expansion joint you would need expansion material. For a construction joint you are possibly going to need wood, a tape measure, and a saw. For the contraction or dummy joint you will need a jointer tool and straightedge.

Step4: Fabricate the joint(s)

FINISH CONCRETE When concrete is firm but not yet completely set, the finishing stage can begin. To begin finishing operations while concrete is still too plastic will yield the same net results as over-floating. One way to tell when the concrete is ready to finish is to watch the water sheen on the surface. When the sheen completely disappears and the surface appears dull and olive green, it is time to finish. Finishing is accomplished with a power trowel (motorized) in large areas and with a hand trowel in smaller areas.

Actual troweling is very similar in practice to floating. Simply rub the concrete surface with the flat part of trowel making long sweeping strokes. As with almost every aspect of concrete construction, experience is the best teacher. The biggest and most often made mistake is overworking the concrete mix. Know when to start finishing and know when to stop. These methods of finishing will leave a smooth surface on the concrete. Most of the projects done within our career field require a non-skid surface. We can use either a soft-bristle broom or burlap material for this result. The broom can be pulled across the surface to place slight indentations in the concrete. The indentations should be perpendicular to the flow of traffic. No pressure should be applied to the broom while pulling it. When using burlap, it is usually pulled along the length of the pavement with approximately one foot of burlap in contact with the surface. Applying a nonskid surface will increase traction during wet weather.

To perform this task, follow these steps:

Step 1: Determine the appropriate type of finish

Knowing the intent of the finished pour will help determine whether the finish should be smooth or non-skid

Step 2: Select the proper tools

Use the broom or burlap material for a non-skid surface. Use a power trowel or hand trowel for a smooth surface.

Step 3. Determine the correct time to finish

Remember to watch the water sheen. As it disappears the concrete will turn a dull, olive green. Begin the finishing procedures at that time.

Step 3. Apply required finish

Use the tools to apply

CURING CONCRETE Curing prevents the rapid loss of moisture from the concrete. As moisture is maintained in the concrete, a chemical reaction between the water and cement causes the concrete to harden. This chemical reaction is referred to as "hydration." The length of hydration and the strength of the concrete are directly related. When hydration stops, strength gain also stops. Concrete will continue to hydrate as long as the exterior surfaces of the concrete remain moist.

Type I cement (the most common type used) should be cured at least 72 hours and preferably 28 days for its designed strength. A three-day (72 hours) curing time will yield concrete of sufficient strength for most jobs.

As soon as the finishing operation is completed, the curing phase will begin. Start curing the concrete immediately after finishing or when the concrete surface is hard enough to resist marking. It's important that once started, curing must be continuous or hydration will stop.

Methods of Curing Concrete can be kept moist by a number of curing methods. These methods can be divided into two classifications: those that supply additional moisture to the concrete, and those that prevent loss of moisture from the concrete by sealing the surface. The most common methods for curing are:

- **Curing Compounds** There are several chemical compounds that when applied to concrete will form a thin membrane covering over the surface. This membrane, if correctly applied, will completely seal in moisture. The advantages of this method are many, but the two biggest advantages are ease of application and the fact that once correctly applied, it requires no further maintenance.

- **Plastic Sheeting** This is an extremely efficient method of curing concrete. Anchor the plastic in such a manner that wind cannot get under it or let moisture escape. Covering edges and joints with sand works well. As moisture evaporates from the surface, it forms droplets on the underside of the plastic and eventually re-deposits onto the concrete surface. This method of curing requires only a spot check every now and then to ensure the edges and joints are still covered.

- **Continuous Water** This method involves simply applying water continually or at regular intervals to the concrete. It is the most troublesome method of curing, but is very efficient. Curing should begin as soon as the concrete is hard enough to resist damage from the water.

- **Burlap and Straw** This method involves covering the surface area with burlap or straw and saturate. The material will hold moisture for several hours (depending on the air temperature) and requires fewer trips back to the job site to apply water than "continuous water" method. The burlap or straw need not be weighted, as the weight of the water will hold it in place.

To perform this task, follow these steps:

Step 1: Decide on the method of curing

Decide on which method; curing compound, plastic sheeting, continuous water or burlap/straw.

Step 2: Gather materials

Step 3: Cure Concrete

Curing time should be between 3 days and 28 days.

Step 4: Remove curing materials once curing is complete (if necessary)

All materials except curing compound must be removed after curing is complete.

Review Questions
for
Construct Rigid Pavement:
Place / Fabricate Joints / Finish / Cure

Question	Answer
1. Prior to actually placing the concrete, you want to _____ the forms so concrete will not stick to them.	a. check for alignment b. consolidate c. screed d. oil
2. Why do we tap the outside of the forms with a hammer?	a. To keep the forms from sticking to the concrete b. To move the aggregate from top to bottom c. To consolidate the edge of the pad d. To keep the forms in line
3. After placing the concrete in the forms you need to _____ the concrete so that it is level with the forms.	a. screed b. jitterbug c. consolidate d. fabricate joint
4. What are the three types of joints?	a. Contraction, construction, and expansion b. Contraction, compressive, and expansion c. Compressive, construction, and expansion d. Contraction, construction, and compressive
5. When does finishing begin?	a. Concrete is set b. After brooming c. As soon as you moisten the base. d. Concrete is firm but not yet completely set
6. A bull float is used for large areas and a hand float is used for small areas.	a. True b. False
7. Which of the following items would be used to obtain a non-skid surface on a recently poured concrete pad?	a. Sandpaper b. Wire brush c. Jitterbug d. Broom

CONSTRUCT RIGID PAVEMENT:

PLACE / FABRICATE JOINTS / FINISH / CURE

Performance Checklist		
Steps for placing rigid pavement	**Yes**	**No**
1. Rechecked form alignment?		
2. Moistened the area?		
3. Oiled forms?		
4. Installed expansion material?		
5. Placed concrete?		
6. Consolidated concrete?		
7. Taped the forms?		
8. Screeded concrete?		
9. Floated concrete?		
10. Edged concrete?		
Steps for installing joints	**Yes**	**No**
1. Determined appropriate type of joints?		
2. Identified location of each joint?		
3. Obtained proper tool/material for joints?		
4. Fabricated joints?		
Steps for finishing concrete	**Yes**	**No**
1. Determined appropriate type of finish?		
2. Selected proper tools?		
3. Determined correct time to finish?		
4. Applied required finish?		
Steps for curing concrete	**Yes**	**No**
1. Decided on method of curing?		
2. Gathered appropriate materials?		
3. Cured concrete?		
4. Removed curing materials once completed (if necessary)?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

RIGID PAVEMENT

MODULE 23 **AFQTP UNIT 2**

CONSTRUCT RIGID PAVEMENT:

REMOVE FORMS (23.2.2.9.)

CONSTRUCT RIGID PAVEMENT: REMOVE FORMS

Task Training Guide

STS Reference Number/Title:	23.2.2.9. Remove Forms
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Hand Tools • Tool Bag • Personal Protective Equipment
Learning Objective:	• The trainee will be able to properly remove forms
Samples of Behavior:	• The trainee will remove forms from a concrete project
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

CONSTRUCT RIGID PAVEMENT:

REMOVE FORMS

Background: Form removal is considered the last formal step in the process of constructing a concrete pad. Remove forms as soon as the concrete has set enough so that the concrete will not be damaged when you remove them. The usual time of removal is 1 to 3 days after the concrete is placed. In cold weather, leave forms in place for 7 days. When removing forms from concrete, always try to pry "up", never "out" from the slab. Prying "out" against the slab will often result in breakage of the slab edges. The main thing when removing forms is to take your time and be careful.

To perform the tasks, follow these steps:

Step 1: Remove Forms

2-by-4 Forms

To remove 2-by-4 forms, hook one point of an ordinary dirt pick under the edge of the form, press your foot down on the other pick point, and pull the pick handle toward you. This will lift the form straight up, without damaging the concrete. As you pull each form, move it away from the new concrete. If you lay the forms on or against the new concrete, you may damage it. If you plan to reuse the wood, remove any nails and dispose of them properly. Clean and stack the forms. The sooner you clean the forms, the easier they will be to clean. Throw away any wood that you can no longer use.

Steel Forms

To remove steel forms, you need to first remove the soil from the stake pockets. Then you loosen the stake wedges, unlock the locking plates, pull the stakes, and lift the form sections. You may have to loosen the stake wedges and locking plates by driving them back with a sledgehammer. It is easier and faster to remove stakes with a mechanical stake puller. It also requires less manpower to accomplish the work. You can also remove stakes by using a front-end loader or other equipment that has a boom attached.

If you use a boom mounted attachment. The boom should rotate or be side mounted, allowing you to drive alongside the forms and pull the stakes. If you use a rear or front-mounted boom, pull up to each stake, pull it, and reposition for the next stake.

Remember, pulling stakes can be accomplished with almost any device that will hold onto them. Another such device is a chain with a pair of heavy pieces of metal (in the shape of washers) welded to the chain. The hole in the washers should be just large enough to go over the stake easily. When you raise the chain, with the boom, the washers will catch the stake at an angle and pull it. To release the stake, straighten the washers so that they will come off.

Once you have removed all the stakes, then you can lift each form section up and away from the concrete. If the form has a keyway bolted to it, or if it has dowels through it, you must move it directly away from the concrete before you lift it. If you have a boom-equipped piece of equipment, use it to lift the form out of place and to load it onto a truck or trailer. If you don't have such equipment, you must free, remove, and load the forms by hand.

After all the forms have been removed and taken back to the shop you want to clean and oil them as soon as possible.

Step 2: Backfill

After forms are removed, backfill with topsoil and compact as necessary to bring soil even with the top edge of the concrete slab. The backfill should slope away from the concrete slab to ensure proper drainage, appearance, and traffic safety. Finally, be sure to clean up the job site before considering the job complete.

Review Questions
for

Construct Rigid Pavement:
Remove Forms

Question	Answer
1. How long should forms be in place before removal?	a. 3 days to 28 days b. 2 days to 38 days c. 1 day to 3 days d. 7 hours to 12 hours
2. When removing forms always pry _____ and away from the concrete.	a. down b. out c. up d. in
3. You want to clean and oil forms as soon as possible after removing them.	a. True b. False
4. After all forms are removed, you want to _____ the area.	a. screed b. backfill c. excavate d. consolidate

CONSTRUCT RIGID PAVEMENT:

REMOVE FORMS

Performance Checklist		
Step	**Yes**	**No**
1. Removed wood and/or steel forms?		
2. Backfilled area?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

RIGID PAVEMENT

MODULE 23 AFQTP UNIT 2

REPAIR DEFECTIVE PAVEMENT:

REMOVE DEFECTIVE PAVEMENT (23.2.3.1.)

REPAIR DEFECTIVE PAVEMENT:

REMOVE DEFECTIVE PAVEMENT

Task Training Guide

STS Reference Number/Title:	23.2.3.1. Remove Defective Pavement
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Concrete Saw • Pneumatic Hammer • Air Compressor • Hand Tools • Tool Bag • Personal Protective Equipment
Learning Objective:	• The trainee will be able to properly remove defective pavement
Samples of Behavior:	• The trainee will remove defective pavement
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

REPAIR DEFECTIVE PAVEMENT:
REMOVE DEFECTIVE PAVEMENT

Background: A concrete saw cuts rigid or flexible pavement to ensure clean, straight, vertical edges which provide for a better patch. Sawing rigid pavement involves the use of a concrete saw equipped with a diamond-tipped blade. This blade is very expensive and if properly cared for, will last a long time. The diamond-tipped blade is sometimes referred to as a wet/dry blade because, while cutting concrete, the blade must have water on it or heat buildup will cause the blade to warp or break. However, if cutting asphalt, water is not required but is still a good idea (check the blade manufacturer's instructions before using the blade without water). The asphalt blade or abrasive blade is utilized for cutting asphalt. This type of blade is made of a special material that does not require water. However, a disadvantage of using this blade is it wears down very quickly and will need frequent changing. It is important for you to know how to utilize both types of blades so that you will be prepared for any situation.

The most common way to remove defective concrete is by use of a pneumatic hammer, commonly called a "jackhammer.

Pneumatic hammers are available in many sizes. For breaking concrete slabs, the pneumatic hammer most commonly used is the 50 to 90-pound class and requires 90 psi of air pressure to operate. A basic rule of thumb is the thicker the concrete, the heavier the hammer. When you use a pneumatic hammer it is absolutely necessary to wear steel toe boots or toe guards, hearing protection, eye protection and hand protection. You must always work inside the sawed area. Never stand outside the defective area to try to break out the pavement. The bit will tend to vibrate against the vertical face and damage the adjacent area.

To perform the tasks, follow these steps:

Step 1: Mark area to be cut

Patch area should be laid out as a rectangle and corners should be square and perpendicular to the flow of traffic. Marking material must be waterproof. Mark the area at least two inches back from the defective area. This will ensure you remove all of the defective material.

Step 2: Perform pre-operational inspection on concrete saw

Refer to local procedures and manuals for proper pre-operational inspection instructions.

Step 3: Start the saw

Ensure that the drive clutch is disengaged and start the engine. The blade will start turning when the engine is started, so be careful. If using the diamond-tip concrete blade, turn on the water system. Hearing protection and goggles are required when using the saw.

SAFETY:
NEVER STAND IN FRONT OF THE SAW WHEN THE ENGINE IS RUNNING.

Step 4: Align saw blade on marked lines for cut

Align the saw blade on line marked for cutting and turn on the water for the blade.

Step 5: Cut

Lower the blade to the desired depth and engage the drive clutch. Make a vertical cut with the saw blade a minimum of 2" deep. Guide the saw along the marked line by making small adjustments from side to side. Don't try to move the saw excessively sideways while its cutting or you could damage the blade. When you reach the end of the cut, disengage the drive clutch, raise the blade and if applicable, turn the water off.

NOTE:
Overlap the cut by ½ the blade width when making corner cuts. This ensures the patch will have square corners.

Step 6: Perform pre-operational inspection on jackhammer and air compressor

Refer to local procedures and manuals for pre-operational checks.

Step 7: Insert bit into hammer

Ensure that the hammerlock is operational.

Step 8: Attach hammer to air hose

Attach the hammer to the air hose and secure it with safety wire.

Step 9: Hammer the pavement

Position hammer as close to the defect as possible. Depress the trigger located on the handle of the hammer. The concrete will begin to crack. Break the concrete into small pieces to make it easier to be picked up.

Step 10: Remove defective pavement

As you jackhammer, stop occasionally to remove pieces. Continue in this manner until the entire defective area is removed.

Review Questions
for

Repair Defective Pavement:
Remove Defective Pavement

Question	Answer
1. Before starting the concrete saw, what should you ensure?	a. No one is standing in front of the blade b. The saw was properly checked out c. The drive clutch is disengaged d. All of the above
2. What is the minimum depth you should cut when using the concrete saw?	a. 1 inch b. 2 inches c. 3 inches d. 4 inches
3. Why should saw cuts overlap at least one-half the blade diameter?	a. To allow for concrete expansion and contraction b. Permits the blade to cool down before finishing c. Ensures the patch will have square corners d. Allows the water from the saw to drain
4. What amount of air pressure does a pneumatic hammer require to operate?	a. 110 psi. b. 100 psi. c. 95 psi. d. 90 psi.
5. What safety equipment is required when operating a pneumatic hammer?	a. Hearing protection b. Steel toed boots c. Eye protection d. All of the above

REPAIR DEFECTIVE PAVEMENT:

REMOVE DEFECTIVE PAVEMENT

Performance Checklist		
Step	**Yes**	**No**
1. Marked area to be cut?		
2. Performed pre-operational check on concrete saw?		
3. Started saw?		
4. Aligned saw?		
5. Cut pavement?		
6. Performed pre-operational check on jackhammer and air compressor?		
7. Inserted bit properly?		
8. Attached hammer to air hose correctly?		
9. Hammered pavement?		
10. Removed all defective pavement?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

RIGID PAVEMENT

MODULE 23 **AFQTP UNIT 2**

CLEAN CONCRETE USING:

HIGH PRESSURE AIR (23.2.3.2.2.)

CLEAN CONCRETE USING:

HIGH PRESSURE AIR

Task Training Guide

STS Reference Number/Title:	23.2.3.2.2. High-Pressure Air
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Air Compressor • Tool Bag • Personal Protective Equipment
Learning Objective:	• The trainee will be able to clean concrete using high-pressure air
Samples of Behavior:	• The trainee will clean concrete using high-pressure air
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

CLEAN CONCRETE USING:

HIGH PRESSURE AIR

Background: Before fresh concrete ever comes in contact with old concrete, the old concrete must be absolutely clean. The cleaner the old concrete, the better the bond with the fresh concrete.

One way of cleaning concrete surfaces is with high-pressure air. The air supplied by the air compressor should be enough to clean most surfaces. No special attachments are required. When cleaning concrete surfaces with high-pressure air, you must observe all safety precautions. Never direct the nozzle toward anyone or straight down at the pavement and wear the appropriate personal protective equipment.

To perform the tasks, follow these steps:

Step 1: Perform pre-operational inspection on air compressor

Refer to local procedures and manuals for proper pre-operational inspection instructions.

Step 2: Ensure all air valves are closed and air hose is secured

Step 3: Start the air compressor

Step 4: Open the air valve and clean the concrete surface

You simply direct the airs blast onto the surface and continue until the surface has no loose particles. When all the debris has been removed, the pavement is clean.

NOTE: Never direct the air nozzle toward anyone or straight down at the pavement.

Step 5: Close the air valve and store hose

Step 6: Shut off air compressor

Review Questions
for

Clean Concrete Using:
High Pressure Air

Question	Answer
1. You should need special adapters for the air hoses when using the air compressor to clean concrete.	a. True b. False
2. What should you never do when using high-pressure air to clean concrete surfaces?	a. Direct the air at anyone b. Use on wet surfaces c. Direct the air straight down d. Both a and c are correct

CLEAN CONCRETE USING:

HIGH PRESSURE AIR

Performance Checklist		
Step	**Yes**	**No**
1. Performed pre-operational inspection on air compressor?		
2. Ensured all air valves were closed and air hose was secured?		
3. Started air compressor correctly?		
4. Opened air valves and cleaned concrete surface?		
5. Closed air valve and stored hose?		
6. Shut off air compressor?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

RIGID PAVEMENT

MODULE 23 **AFQTP UNIT 2**

MIX/PLACE AND REPAIR PATCHES USING:

PORTLAND CEMENT CONCRETE (23.2.3.3.1.)

MIX/PLACE AND REPAIR PATCHES USING:

PORTLAND CEMENT CONCRETE

Task Training Guide

STS Reference Number/Title:	23.2.3.3.1. Portland Cement Concrete
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Cement • Sand • Gravel • Water • Portable Concrete Mixer • Hand Tools • Tool Bag • Personal Protective Equipment
Learning Objective:	• The trainee will be able to properly mix and place concrete for patches
Samples of Behavior:	• The trainee will mix and place concrete for patches
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

MIX/PLACE AND REPAIR PATCHES USING: PORTLAND CEMENT CONCRETE

Background: You must determine how much concrete it will take to do the job. Large jobs may require that concrete be purchased from a concrete batch plant and delivered in a transit mixer. Small quantities may be mixed in a portable concrete mixer or by hand.

If you are not using original slab specifications, a standard field mix of 1 cu. ft. of cement, 2 cu. ft. of sand, 3 cu. ft. of gravel and water can be used with satisfactory results. Mix the ingredients thoroughly and keep the mix as dry as possible so it will set faster. For fast repairs, the best type of Portland cement to use is Type III.

Before we discuss the concrete mixer, let's talk about a few safety precautions. Always remove any jewelry and keep loose clothing away from the turning drum. Keep all unnecessary personnel away from the machine while it is operating. Stay upwind of the cement dust as you load the mixer.

Operation of the concrete mixer begins with a pre-operational inspection. Service and grease it as needed. Start the engine and let it warm up before setting the throttle to the operating speed. Put 10% of the water in the mixer drum. Then add the cement, sand, gravel, and the rest of the water. Mix the ingredients thoroughly for at least one minute.

After concrete is thoroughly mixed, it must be transported to the patch site and placed as soon as possible. When transporting in wheelbarrows, be careful to minimize mix segregation. Jarring the wheelbarrow over rough ground will cause large aggregate to settle and cause a watery paste to come to the surface. This mix segregation will weaken the concrete considerably.

To perform this task, follow these steps:

Step 1: Determine amount of concrete required for patch

Step 2: Perform pre-operational inspection on portable concrete mixer

Step 3: Start the concrete mixer

Step 4: Mix the concrete

Use the standard field mix (ratio) to make the concrete. After all ingredients are added mix for at least minute.

Step 5: Transports the concrete to the repair area

Mixing and placing as close to the repair area as possible can prevent segregation. Traveling over great distances increases the chances of segregation.

Step 6: Install expansion material (if necessary)

A joint must be placed between the old and new concrete to relieve the compressive stresses that will occur as the concrete expands and contracts. These joints may consist of any compressible material, placed between the old and new slab.

Step 7: Apply an epoxy or Portland cement bonding agent

Use an epoxy or Portland cement bonding agent on the vertical faces of the repair area. This aids in bonding between the old and new concrete. A good bonding agent to use prior to placing concrete would be a mixture of one part portland cement, one part sand, and water.

Step 8: Place concrete in hole

Avoid long distance wheelbarrow trips as this causes coarse aggregates to settle to the bottom. Place concrete as near as possible to its final resting-place.

Step 9: Consolidate

Consolidate to eliminate any stone pockets and large pockets of air. Use a jitterbug, roller screed, or other tools suitable for this task. Use consolidating tools sparingly, otherwise the concrete will segregate.

Step 10: Screed

Remove excess concrete and leave a level, but rough surface.

Step 11: Float

After screeding is completed, the concrete should be floated as necessary with a wood or metal float. Floating too much will bring excessive amounts of cement/water paste to the surface and must be avoided at all costs. Excessive surface paste weakens the surface and can cause it to chip and break under little or no stress.

Step 12: Edge

During floating of the concrete, you can use the edging tool to place an edge on the concrete if required.

Step 13: Install joints

You may need to install expansion, contraction, and/or construction joints.

Step 14: Finish

Finishing will begin when the concrete begins to firm up, but before it sets. To tell when the concrete is ready to finish, watch the water sheen on the surface. When the sheen disappears and the surface appears dull and olive green, it is time to finish. If a smooth finish is required use a trowel; if a non-skid finish is needed use a broom or burlap.

Step 15: Cure

When finishing operations are complete, curing will start either by keeping the surface damp for several days or by applying membrane-curing compounds. Use whichever method is best for you. Just make sure you cure the concrete for a minimum of 72 hours.

Review Questions
for
Mix/Place and Repair Patches Using:
Portland Cement Concrete

Question	Answer
1. What is a standard field mix?	a. 1 cu. ft. of cement, 2 cu. ft. of sand, 3 cu. ft. of gravel b. 1 cu. ft. of sand, 2 cu. ft. of cement, 3 cu. ft. of gravel c. 1 cu. ft. of gravel, 2 cu. ft. of sand, 3 cu. ft. of cement d. 1 cu. ft. of cement, 2 cu. ft. of gravel, 3 cu. ft. of sand
2. How much water do you place in the mixer before adding the dry ingredients?	a. 40% b. 30% c. 20% d. 10%
3. What is the minimum mix time after all the ingredients are added to the mixer?	a. 5 minutes b. 4 minutes c. 2 minutes d. 1 minute
4. When patching numerous small areas around base you can mix several cubic yards of concrete in the shop and transport to various sites to make repairs.	a. True b. False
5. Consolidation is necessary to eliminate _____.	a. stone pockets b. air pockets c. water spots d. Both a and b
6. The curing time of the concrete requires a minimum of _____.	a. 4 hours b. 12 hours c. 36 hours d. 72 hours

MIX/PLACE AND REPAIR PATCHES USING:
PORTLAND CEMENT CONCRETE

Performance Checklist		
Step	**Yes**	**No**
1. Determined amount of concrete required?		
2. Performed pre-operational inspection on concrete mixer?		
3. Started mixer correctly?		
4. Mixed concrete using standard field mix?		
5. Transported concrete?		
6. Installed expansion material?		
7. Applied bonding agent?		
8. Placed Concrete?		
9. Consolidated concrete?		
10. Screed concrete?		
11. Floated concrete?		
12. Edged concrete? (If required)		
13. Installed Joints? (If required)		
14. Finished concrete?		
15. Cured concrete?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

FLEXIBLE PAVEMENT

MODULE 23 **AFQTP UNIT 3**

BITUMINOUS MATERIALS:

APPLY BITUMINOUS MATERIAL (23.3.1.3.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training if equipment is available. It is to be used in conjunction with these for training purposes only.

BITUMINOUS MATERIALS:

APPLY BITUMINOUS MATERIAL

Task Training Guide

STS Reference Number/Title:	23.3.1.3. Apply Bituminous Material
Training References:	• Local Technical Order • Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Prime or Tack Coat and Applicator • Personal Safety Equipment • General Tool Kit
Learning Objective:	• The trainee will be able to properly apply a prime or tack coat.
Samples of Behavior:	• The trainee will apply prime or tack coat.
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

BITUMINOUS MATERIALS:

APPLY BITUMINOUS MATERIAL

Background: A prime coat is defined as a light application of a liquid bituminous material applied to an absorbent surface.

- **Materials** For dense surfaces (few voids), SS-1 asphalt emulsion or MC 30 asphalt cutback is recommended because of its ability to penetrate. MC 70 will also work well on dense bases, but will not penetrate as easily as MC 30. For a more open surface (highly absorbent), an MC 250 can be used. MC 250 works well only if the surface is open enough to allow penetration of this heavier material. Grades heavier than 250 are not recommended for priming.

- **Purposes** A properly applied prime coat will create a waterproof membrane between the base course and the bituminous pavement. This membrane will prevent the movement of moisture through capillary voids from the subgrade through the base and into the pavement itself. It will also prevent moisture entering through cracks in the pavement (in later years) from penetrating the base course and subgrade. Prime coats also provide a bond between the pavement and the base course. This bond is especially important when constructing relatively thin pavements that might otherwise have a tendency to shift under traffic loads.

Tack coats are defined as a light application of a liquid bituminous material applied to a non-absorbent surface.

- **Materials.** A tack coat must have three essential requirements to be effective. It must be very thin, it must uniformly cover the entire surface of the area to be paved, and it must wet the old surface so it will adhere to the new surface. It is because of these requirements that SS-1 asphalt emulsion, diluted with equal parts water is recommended.

- **Purpose.** The main reason for using a tack coat is to provide a bond between the old existing pavement and the "overlay" being placed on it. Without this bond, the new pavement (overlay) might tend to shift and crack under the traffic load. It also helps to seal the old pavement prior to overlaying it. This prevents moisture from becoming trapped between the two pavements.

To perform this task, follow these steps:

Step 1: Determine Application Method

Prime and Tack-coats are placed with an asphalt distributor if the size of the area permits. Hand spreaders are normally used for smaller areas where a distributor would be impractical.

Step 2: Determine Rate of Application

The rate of application will vary according to the type of material being used and the absorbency of the surface being primed or tacked. Rate for prime coat can vary from .10 gallons per square yard up to .25 gallons per square yard. The rate of application for tack coat must stay between .05 gallons per square yard and .15 gallons per square yard depending on the condition of the old pavement. The surface must be clean before applying a tack coat.

Step 3: Apply Material

A prime coat requires 24 hours for liquid penetration and should be fully set or cured before placing the pavement. A tack coat must be tacky to the touch before the paving material is placed. It is better to apply too little than to apply too much tack-coat. Over-application leads to bleeding in the pavement itself, and may prevent the desired bond. Excess tack coat tends to act as a lubricant rather than an adhesive. It is important to plan your work so that no more than the necessary tack-coat for the day's operation is placed on the surface.

Review Questions
for
Bituminous Materials

Apply Bituminous Material

Question	Answer
1. What is the definition of a prime coat?	a. A light application of liquid bituminous material applied to an absorbent surface b. A heavy application of liquid bituminous material applied to an absorbent surface c. A light application of liquid bituminous material applied to a non-absorbent surface d. A heavy application of liquid bituminous material applied to a non-absorbent surface
2. What is the definition of a tack coat?	a. A light application of liquid bituminous material applied to an absorbent surface b. A heavy application of liquid bituminous material applied to an absorbent surface c. A light application of liquid bituminous material applied to a non-absorbent surface d. A heavy application of liquid bituminous material applied to a non-absorbent surface
3. What is the application rate for a prime coat?	a. .01 gal. Sq. yd. - .05 gal. Sq. yd. b. .10 gal. Sq. yd. - .25 gal. Sq. yd. c. .01 gal. Sq. ft. - .05 gal. Sq. ft. d. .10 gal. Sq. ft. - .25 gal. Sq. ft.
4. What is the application rate for a tack coat?	a. .01 gal. Sq. yd. - .05 gal. Sq. yd. b. .05 gal. Sq. yd. - .10 gal. Sq. yd. c. .05 gal. Sq. ft. - .15 gal. Sq. ft. d. .10 gal. Sq. ft. - .15 gal. Sq. ft.

BITUMINOUS MATERIALS:

APPLY BITUMINOUS MATERIAL

Performance Checklist		
Step	**Yes**	**No**
1. Accurately determined application method?		
2. Accurately determined rate of application?		
3. Applied material correctly?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

FLEXIBLE PAVEMENT

MODULE 23 **AFQTP UNIT 3**

REPAIR DEFECTIVE PAVEMENT:

REMOVE (23.3.3.1.)

REPAIR DEFECTIVE PAVEMENT:

REMOVE

Task Training Guide

STS Reference Number/Title:	23.3.3.1. Remove
Training References:	• Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Concrete Saw • Pneumatic Hammer • Air Compressor • Hand Tools • Tool Bag • Safety Equipment
Learning Objective:	• The trainee will be able to properly remove defective pavement.
Samples of Behavior:	• The trainee will remove defective pavement.
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

REMOVE

Background: A concrete saw cuts rigid or flexible pavement to ensure clean, straight, vertical edges which provide for a better patch. Sawing flexible pavement involves the use of a concrete saw equipped with a diamond-tipped blade or an abrasive blade. The diamond-tipped blade is very expensive and if properly cared for, will last a long time. This blade is sometimes referred to as a wet/dry blade because, while cutting concrete, the blade must have water on it or heat buildup will cause the blade to warp or break. However, if cutting asphalt water is not required but still a good idea (check with the blade manufacturer's instructions before using the blade without water). The asphalt blade or abrasive blade is utilized for cutting asphalt. This type of blade is made of a special material that does not require water. However, a disadvantage of using this blade is it wears down very quickly and will need frequent changing.

There are a couple of ways to remove defective asphalt after it has been saw cut. You can use a pneumatic hammer or a backhoe to "pop" the defective material out of the hole. The most common way to remove defective concrete is by use of a pneumatic hammer, commonly called a "jackhammer. Pneumatic hammers are available in many sizes. For breaking concrete slabs, the pneumatic hammer most commonly used is the 50 to 90-pound class and requires 90 psi of air pressure to operate. A basic rule of thumb is the thicker the concrete, the heavier the hammer. When you use a pneumatic hammer for asphalt you can use the same size as you would for concrete, but you may want to use one that is smaller. It really depends on the thickness of pavement and how hard the material is to break up.

When you use the jackhammer to break up pavement, it is absolutely necessary to wear steel toe boots or toe guards, hearing protection, eye protection and hand protection. You also need to ensure others working with you have on the appropriate personal protective equipment.

Typically, you should stand inside the sawed area as you break up the defective material. This prevents the bit from vibrating against the vertical face of the repair area and causing damage to the adjacent areas.

To perform this task, follow these steps:

Step 1: Mark area to be cut

Patch area should be laid out as a rectangle and corners should be square and perpendicular to traffic. Marking material must be waterproof. Mark the area at least one foot back from the defective area. This will ensure you remove all of the defective material.

Step 2: Perform pre-operational inspection on concrete saw

Refer to local procedures and manuals for proper pre-operational inspection instructions.

Step 3: Start the saw

Ensure that the drive clutch is disengaged and start the engine. The blade will start turning when the engine is started, so be careful. If using the diamond-tip concrete blade, turn on the water system. Hearing protection and goggles are required when using the saw.

SAFETY:
NEVER STAND IN FRONT OF THE SAW WHEN THE ENGINE IS RUNNING.

Step 4: Align saw blade on marked lines for cut

Step 5: Cut

Lower the blade to the desired depth and engage the drive clutch. Make a vertical cut with the saw a minimum of 2" deep. Guide the saw along the marked line by making small adjustments from side to side. Don't try to move the saw excessively sideways while it is cutting, you could damage the blade. When you reach the end of the cut, disengage the drive clutch, raise the blade, and if applicable, turn the water off.

NOTE:
Overlap the cut by ½ the blade width when making corner cuts. This ensures the patch will have square corners.

Step 6: Perform pre-operational inspection on jackhammer and air compressor

Refer to local procedures and manuals for pre-operational checks.

Step 7: Insert bit into hammer

Ensure the hammerlock is operational. The best bit to use for removing asphalt is the 5" asphalt cutter or the standard 3" chisel.

Step 8: Attach hammer to air hose

Attach the hammer to the air hose and secure it with safety wire.

Step9: Start the air compressor

Step 10: Hammer the pavement

Position hammer as close to the defect as possible. Depress the trigger located on the handle of the hammer. Break the asphalt into small pieces to make it easier to be picked up.

Step 11: Remove the defective pavement

Stop occasionally to remove pieces. Continue in this manner until the entire defective area is removed.

Review Questions
for

Repair Defective Pavement:
Remove

Question	Answer
1. Before starting the concrete saw, what should you ensure?	a. That no one is standing in front of the blade b. The saw was properly checked out c. The drive clutch is disengaged d. All of the above
2. What is the minimum depth you should cut when using the concrete saw?	a. 1 inch b. 2 inches c. 3 inches d. 4 inches
3. Why should saw cuts overlap at least one-half the blade diameter?	a. To allow for asphalt expansion and contraction b. Permits the blade to cool down before finishing c. Ensures the patch will have square corners d. Allows the water from the saw to drain
4. What amount of air pressure does a pneumatic hammer require to operate?	a. 110 psi b. 100 psi c. 95 psi d. 90 psi
5. What safety equipment is required when operating a pneumatic hammer?	a. Hearing protection b. Steel toed boots c. Eye protection d. All of the above

REPAIR DEFECTIVE PAVEMENT:

REMOVE

Performance Checklist		
Step	**Yes**	**No**
1. Performed pre-operational check on concrete saw?		
2. Started saw?		
3. Aligned saw?		
4. Cut area?		
5. Performed pre-operational check on jackhammer and air compressor?		
6. Inserted bit?		
7. Attached hammer?		
8. Started air compressor properly?		
9. Hammered pavement?		
10. Removed defective pavement?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

FLEXIBLE PAVEMENT

MODULE 23 **AFQTP UNIT 3**

REPAIR DEFECTIVE PAVEMENT:

REPLACE (23.3.3.2.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training if equipment is available. It is to be used in conjunction with these for training purposes only.

REPAIR DEFECTIVE PAVEMENT:

REPLACE

Task Training Guide

STS Reference Number/Title:	23.3.3.2. Replace
Training References:	• Local Technical Order • Local Procedures
Prerequisites:	• Possess as a minimum a 3E231 AFSC
Equipment/Tools Required:	• Asphalt tools • Compaction Equipment • Personal Safety Equipment • General Tool Kit
Learning Objective:	• The trainee will be able to properly replace defective flexible pavement
Samples of Behavior:	• The trainee will replace defective flexible pavement
Notes:	
• Personnel are required to wear all personal protective equipment pertaining to each task (i.e. work gloves, hearing protection, and safety goggles)	
• Any safety violation is an automatic failure	

REPAIR DEFECTIVE PAVEMENT:

REPLACE

Background: Care and good judgment are necessary in applying suitable methods and in selecting proper materials for maintenance and repairs of bituminous surfaces. Both methods and materials vary considerably with local conditions, but the principle of bituminous work stays the same. Flexible pavements should be repaired with the same materials used to build them. These materials consist of all forms of bitumen and various grades of aggregate.

To perform this task, follow these steps:

Step1: Determine amount of asphalt required

The first step is to select and obtain a sufficient quantity of bituminous paving material. Try to use a hot-mix material if possible. Hot-mix is stronger and lasts longer. If cold-mix material is used, the patch may have a porous surface and require a sand seal to waterproof it.

Step 2: Place Asphalt

For hot-mix, the area should be overfilled approximately 40% of its pavement thickness, to allow for compaction. Cold mixtures should be spread and rolled in 2" to 3" layers. When spreading cold-mix materials, keep the material as level as possible. Both hot and cold mixes can be spread by hand, grader, or spreaders depending on the size of the repair.

Step 3: Roll Transverse Joints

This joint is rolled transversely, or perpendicular to traffic flow, with the steel-wheeled roller on the previously rolled material, except for a 6" overlap onto the newly placed asphalt. This operation should be repeated with successive passes covering 6"-8" of fresh material until the entire width of the drive wheel is on the new mix. Boards of the proper thickness should be in place at the edge of the pavement to provide for off the pavement movement of the roller. To prevent water infiltration, you should always start the rolling along the edges first.

Step 4: Roll Longitudinal Joints

Longitudinal joints should be rolled directly behind the paving operation. The steel-wheeled roller should be shifted to the previously placed lane so that not more than 6" rides on the edge of the fine material left by brooming and bumping. This will prevent the asphalt from dishing out at the joint.

Step 5: Breakdown Rolling

Breakdown rolling is best done with steel-wheeled rollers. The weight of the roller used for breakdown rolling depends, to a large degree, upon the temperature, thickness, and stability of the mix being placed. Generally, a roller weighing from 8 to 10 tons is used for this operation.

NOTE:
It is impossible to start rolling operations on the low side of the spread, start at the outside of the lane being paved and progress toward the high side.

NOTE:
- The rolling pattern only includes the number of passes, but also the location of the pass. The sequence of succeeding passes and the overlapping between passes with 3" - 4" of the drum remaining on the compacted material.
- Sharp turns and quick starts or stops must be avoided. The greatest percentage of compacting occurs during a breakdown pass (80% -90% of total compaction).
- When rolling, ensure the drive wheel is nearest the paver or in the forward direction of the rolling operation. There are exceptions to rolling with the drive wheel forward. The exception to having the drive wheel first is when you are compacting material up a grade in this case, the roller must be turned around to allow the tiller wheel to partially compact the material so the drive wheel can then proceed over it.

Step 6: Intermediate Rolling

The second or intermediate rolling should closely follow breakdown rolling while the asphalt mix is still plastic and at a temperature that will result in maximum density. Intermediate rolling should be continuous after breakdown rolling until all of the mix has been thoroughly compacted. At least three passes should be made. Like break down rolling, sharp turns and quick starts or stops must be avoided.

Step 7: Finish Rolling

Finish rolling is done solely to remove roller marks. It should be done with steel-wheeled tandems or vibratory rollers with the vibrator turned off while the material is still warm enough for removal of roller marks.

HINT:
Hot mix asphalt is cool enough to finish roll when you can place your hand on the hot asphalt for five seconds without burning your hand.

Review Questions
for

Repair Defective Pavement:
Replace

Question	Answer
1. What is the overlap of the drum when rolling asphalt?	a. 1 to 3 inches b. 3 to 4 inches c. 6 to 8 inches d. 8 to 10 inches
2. When the steel wheel roller is rolling, what is the speed it should not exceed?	a. 1 mph b. 3 mph c. 5 mph d. 10 mph
3. Which of the following is the correct sequence of rolling?	a. Longitudinal, transverse, breakdown, finish b. Transverse, breakdown, longitudinal, finish c. Breakdown, transverse, longitudinal, finish d. Transverse, longitudinal, breakdown, finish
4. What is the purpose of finish rolling?	a. Remove roller marks b. Consolidate the material c. Achieve maximum density d. To prevent the material from dishing out
5. You should roll along the edges first to prevent _____.	a. dishing out b. speed bumping c. excessive cooling d. water infiltration

REPAIR DEFECTIVE PAVEMENT:

REPLACE

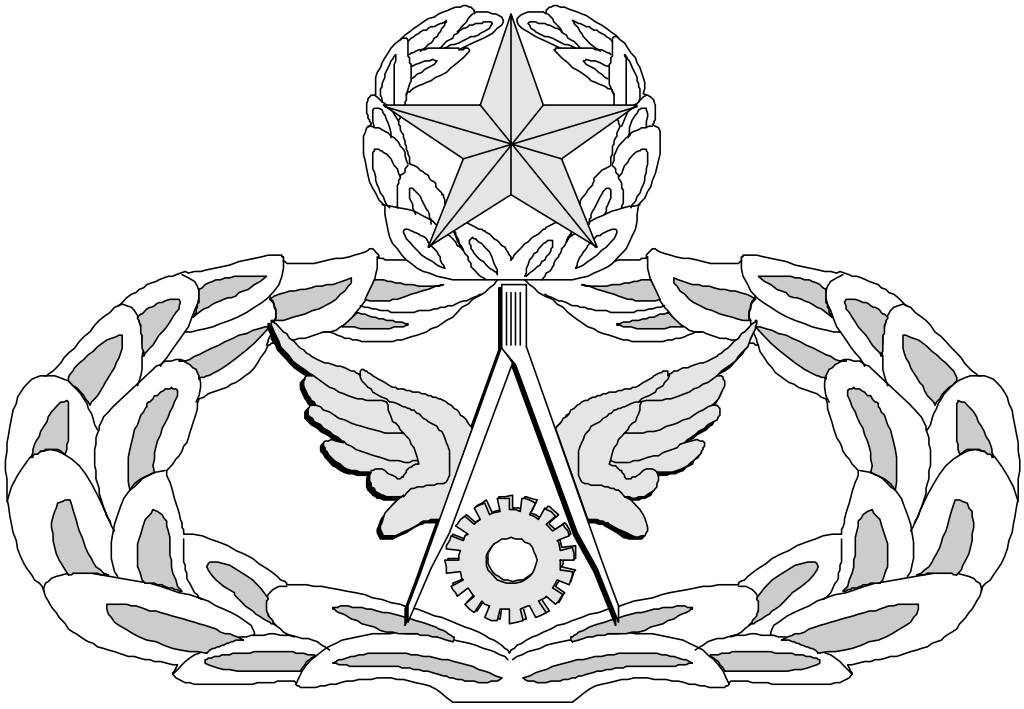
Performance Checklist		
Step	**Yes**	**No**
1. Determined amount of asphalt required?		
2. Placed asphalt?		
3. Rolled transverse joints?		
4. Rolled longitudinal joints?		
5. Conducted breakdown rolling?		
6. Conducted intermediate rolling?		
7. Conducted finished rolling?		

FEEDBACK: Trainer should provide positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

Air Force Civil Engineer

QUALIFICATION TRAINING PACKAGE (QTP)

REVIEW ANSWER KEY



For

PAVEMENTS & CONSTRUCTION EQUIPMENT OPERATOR

(3E2X1)

MODULE 23

PAVED SURFACES

LAY OUT AREA
(3E2X1-23.1.1.)

Question	Answer
1. What is the first step when laying out a small area?	c. Measure the area using a tape measure
2. What is one method used to ensure the corners are square?	a. Measure diagonally across corners

CLEAR ARE USING:
HAND TOOLS
(3E2X1-23.1.2.1.)

Question	Answer
1. What hand tools are used to dig up stumps and roots?	d. All of the above
2. Which hand tool is used for chopping down saplings or very small trees?	a. Axe
3. What hand tool is used to cut down small to very large trees?	d. Chainsaw

CLEAR AREA USING:
CONSTRUCTION EQUIPMENT
(3E2X1-23.1.3.2.)

Question	Answer
1. What equipment is typically used to clear large areas of vegetation, brush, trees and rocks?	a. Bulldozer
2. How should you remove medium size trees (12 to 18 inches in diameter) with a bulldozer?	c. Blade raised high, push tree over and back up to prevent roots from lifting dozer
3. The dozer should use the _____ step process to remove large trees (12 – 30 inch) diameter.	d. 4

EXCAVATE AREA USING:
HAND TOOLS
(3E2X1-23.1.3.1.)

Question	Answer
1. What determines whether a project should be excavated by hand or by using equipment?	a. Size
2. Which hand tool is used for moving and leveling loose soil?	b. Square point shovel
3. What hand tool is used to loosen dry, hard material such as clay?	a. Pick
4. The excavation must be deep enough to allow for what two factors?	a. Base course and pavement thickness

EXCAVATE AREA USING:
CONSTRUCTION EQUIPMENT
(3E2X1-23.1.3.2)

Question	Answer
1. Skid steer loaders are ideal for _____ excavation in small to medium size projects.	a. Light
2. What equipment is better suited for light to medium excavation in medium to large projects?	d. Front-end loader
3. What equipment is used for deep excavation?	a. Backhoe
4. The excavation must be deep enough to allow for what two factors?	a. Base course and pavement thickness

PREPARE SUBGRADE: STABILIZE (3E2X1-23.1.4.1.)

Question	Answer
1. What type of chemical would you add to granular, crumbly soil?	d. Bituminous materials
2. Lime is used to stabilize _____.	b. Clay
3. What are the two types of stabilization?	b. Mechanical and chemical
4. Mechanical stabilization means mixing _____with_____.	a. soil; soil

PREPARE SUBGRADE: COMPACTION (3E2X1-23.1.4.2)

Question	Answer
1. The purpose of compaction is to increase the subgrades _____.	c. density
2. Compaction prevents shearing and _____ when loads are applied.	a. settlement
3. Which roller is best used on granular soils with little or no fine such as sand and gravel mixtures?	c. Steel Wheel
4. Which roller is best used for clay soils?	a. Sheepsfoot

PREPARE BASE COURSE: PLACE (3E2X1-23.1.5.1.)

Question	Answer
1. A good base course is made up of _____.	a. 50% well graded gravel, 40% well graded sand, and 10% slightly plastic silt
2. If sub-grade strength is low, then the base course must be _____.	d. none of the above
3. When placing the base course, try to prevent _____.	b. segregation

PREPARE BASE COURSE: COMPACTION (3E2X1-23.1.5.2)

Question	Answer
1. When using small compaction equipment the thickness of each layer should be _____.	d. 3 inches or less
2. When using large compaction equipment the thickness of each can be as much as _____ inches.	b. 6
3. The base course must be compacted to _____.	b. a tight water shedding surface.

COMPUTE MATERIALS REQUIRED
(3E2X1-23.1.6.)

Question	Answer
1. What is the application rate for prime coat?	b. .10 to .25 gallons per square yard
2. How much does one cubic foot of cold mix weigh?	b. 90 pounds
3. Why do you divide the total weight of asphalt by 2000?	d. To convert pounds to tons
4. How do you convert inches into a decimal part of a foot?	c. Divide by 12
5. What is the radius of a circle?	a. Half the diameter
6. How is base course ordered?	d. By the ton
7. How many cubic feet are in one cubic yard?	d. 27

CONSTRUCT RIGID PAVEMENT:
INSTALL FORMS
(3E2X1-23.2.2.1.)

Question	Answer
1. Why place soil behind the forms?	a. To prevent concrete from getting in the stake holes.
2. How do you ensure proper elevation of a form?	b. By aligning the top inside edge of the form with the string line.
3. What is the length of metal forms?	a. 10’

CONSTRUCT RIGID PAVEMENT: INSTALL REINFORCING MATERIALS (3E2X1-23.2.2.2)

Question	Answer
1. What is the purpose of reinforcing steel?	c. To increase the tensile strength of the hardened concrete
2. What are the types of reinforcing steel?	a. Rebar and welded wire fabric
3. When using wire mesh for reinforcement, how is it positioned in the pour area?	a. Using chairs or pulled to the center with a hook device

CONSTRUCT RIGID PAVEMENT: PLACE / FABRICATE JOINTS / FINISH / CURE (3E2X1-23.2.2.5. & 23.2.2.6. & 23.2.2.7. & 23.2.2.8.)

Question	Answer
1. Prior to actually placing the concrete, you want to _____ the forms so concrete will not stick to them.	d. oil
2. Why do we tap the outside of the forms with a hammer?	c. To consolidate the edge of the pad.
3. After placing the concrete in the forms you need to _____ the concrete so that it is level with the forms.	a. screed
4. What are the three types of joints?	a. Contraction, construction, and expansion.
5. When does finishing begin?	d. Concrete is firm but not yet completely set
6. A bull float is used for large areas and a hand float is used for small areas.	a. True
7. Which of the following items would be used to obtain a non-skid surface on a recently poured concrete pad?	d. Broom

CONSTRUCT RIGID PAVEMENT: REMOVE FORMS (3E2X1-23.2.2.9.)

Question	Answer
1. How long should forms be in place before removal?	c. 1 day to 3 days.
2. When removing forms always pry _____ and away from the concrete.	c. up
3. You want to clean and oil forms as soon as possible after removing them.	a. True
4. After all forms are removed, you want to _____ the area.	b. backfill

REPAIR DEFECTIVE PAVEMENT: REMOVE (3E2X1-23.2.3.1.)

Question	Answer
1. Before starting the concrete saw what should you ensure?	d. All of the above
2. What is the minimum depth you should cut when using the concrete saw?	b. 2 inches
3. Why should saw cuts overlap at least one-half the blade diameter?	c. Ensures the patch will have square corners
4. What amount of air pressure does a pneumatic hammer require to operate?	d. 90 psi
5. What safety equipment is required when operating a pneumatic hammer?	d. All of the above

CLEAN CONCRETE USING: HIGH PRESSURE AIR (3E2X1-23.2.3.2.2.)

Question	Answer
1. You should need special adapters for the air hoses when using the air compressor to clean concrete.	b. False
2. What should you never do when using high-pressure air to clean concrete surfaces?	d. Both a and c are correct

MIX/PLACE AND REPAIR PATCHES USING: PORTLAND CEMENT CONCRETE (3E2X1-23.2.3.3.1.)

Question	Answer
1. What is the standard field mix?	a. 1 cubic foot of cement, 2 cubic foot of sand, 3 cubic foot of gravel
2. How much water do you place in a mixer before adding the dry ingredients?	d. 10%
3. What is the minimum mix time after all the ingredients are added to the mixer?	d. 1 minute
4. When patching numerous small areas around base you can mix several cubic yards in the shop and transport to various fill areas.	b. False
5. Consolidation is necessary to eliminate _____.	d. Both a and b
6. The curing time of concrete requires a minimum of _____.	d. 72 hours

BITUMINOUS MATERIALS:
APPLY BITUMINOUS MATERIAL
(3E2X1-23.3.1.3.)

Question	Answer
1. What is the definition of a prime coat?	a. A light application of liquid bituminous material applied to an absorbent surface
2. What is the definition of a tack coat?	c. A light application of liquid bituminous material applied to a non-absorbent surface.
3. What is the application rate for a prime coat?	b. 10 gallons per square yard - .25 gallons per square yard.
4. What is the application rate for a tack coat?	c. .05 gal. Sq. yd - .15 gal Sq. yd.

REPAIR DEFECTIVE PAVEMENT:
REMOVE
(3E2X1-23.3.3.1.)

Question	Answer
1. Before starting the concrete saw what should you ensure?	d. All of the above
2. What is the minimum depth you should cut when using the concrete saw?	b. 2 inches
3. Why should saw cuts overlap at least one-half the blade diameter?	c. Ensures the patch will have square corners
4. What amount of air pressure does a pneumatic hammer require to operate?	d. 90 psi
5. What safety equipment is required when operating a pneumatic hammer?	d. All of the above

REPAIR DEFECTIVE PAVEMENT
REPLACE
(3E2X1-23.3.3.2.)

Question	Answer
1. What is the overlap of the drum when rolling asphalt?	c. 6 to 8 inches
2. When the steel wheel roller is rolling what is the speed it should not exceed?	c. 5 mph
3. Which of the following is the correct sequence of rolling?	d. Transverse, longitudinal, breakdown, finish
4. What is the purpose of finish rolling?	a. Remove roller marks
5. You should roll along the edges first to prevent _____.	d. water infiltration